MPAA 2012/2013
ESTUDIOS OFICIALES
DE MÁSTER Y DOCTORADO
EN PROYECTOS
ARQUITECTÓNICOS
AVANZADOS

Towards an Active Design. An Approach on the Body Interaction with the Built Environment.

Marco Ruben Duarte Pereira Vitório

Línea 3. Procesos de Inovación Tecnológica en Arquitectura
Directora de tesis: Atxu Amman Alcocer

m.ruben@alumnos.upm.es

ES

RESUMEN. El impacto de la tecnología en el ambiente construido y en las actividades en él desarrolladas, es una de las causas de la progresiva sedentarización de la especie humana. Desde un enfoque que analiza la interacción del cuerpo con la arquitectura, a través de distintas referencias en escalas diversas, esta investigación intenta establecer la relación entre la evolución del ambiente pasivo y la sedentarización, proponiendo frente a un espacio mecanizado y digitalizado que disminuye la actividad física humana, la búsqueda de nuevos tipos de espacios arquitectónicos que promuevan el movimiento repercutiendo en el bienestar y la salud.

Esta tesis estudia por tanto el impacto de la tecnología en el espacio, intentando aproximarse a estrategias que disminuyan el efecto pasivo y estimulen la actividad motora. Estas propuestas abarcan tanto la ciudad, como la edificación y el propio espacio doméstico afectando a los sistemas de circulación, a la configuración espacial y sobre todo a la incorporación de "espacios activos", en donde se contempla la posibilidad de un uso alternativo de la tecnología como un elemento positivo.
PALABRAS CLAVE: Diseño Activo; Cuerpo; Ambiente Construído; Circulación; Actividad Física; Tecnologia; Arquitectura.

EN

ABSTRACT. THE IMPACT OF TECHNOLOGIES ON THE BUILT ENVIRONMENT AND HUMAN ACTIVITY IS ONE OF THE CAUSES OF SEDENTARIZATION. THROUGH AN APPROACH THAT ANALYZES THE BODY INTERACTION WITH ARCHITECTURE, USING DIFFERENT REFERENCES IN DIFFERENT SCALES, THIS RESEARCH WILL ELABORATE THE RELATIONSHIP BETWEEN THE EVOLUTION OF THE PASSIVE ENVIRONMENT AND SEDENTARIZATION OF THE CONTEMPORARY ARCHITECTURE, CONTENDING THAT THE MECHANIZED AND DIGITALIZED SPACE DECREASES HUMAN PHYSICAL ACTIVITY, WHILE A SPACE DIRECTED TO PROMOTE MOVEMENT WILL INCREASE HUMAN ACTIVITY AND HEALTH.

THIS THESIS WILL DISCUSS THE INFLUENCE OF TECHNOLOGY IN THE SPACE APPROACHING STRATEGIES THAT DECREASE THE PASSIVE EFFECT AND THAT STIMULATE PHYSICAL ACTIVITY.THESE PROPOSALS ADDRESS THE CITY, AS WELL AS THE SPATIAL CONFIGURATION AND ESPECIALLY THE INCORPORATION OF "ACTIVE SPACES", WHERE THE POTENTIAL OF TECHNOLOGY IS ALSO APPROACHED AS POSITIVE ELEMENT FOR ACTIVE DESIGN.
KEYWORDS: Active Design; Body; Built Environment; Circulation; Physical Activity; Technology; Architecture.

Towards an Active Design

Index

Definitions

Active Design: Environmental design that encourages stair climbing, walking, bicycling, transit use, active recreation, and healthy eating (Burney et al. 2010 6); therefore environments that support or discourage health behaviors that critically influence health (Gebel et al. 2005 6).

Body: The physical structure, including the bones, flesh, and organs, of a person or an animal (Oxford Dictionaries 2013).

Built Environment: The term built environment refers to the human-made surroundings that provide the setting for human activity, ranging in scale from buildings and parks or green space to neighborhoods and cities that can often include their supporting infrastructure, such as water supply, or energy networks (Wikipedia 2013).

Walkability: Walkability reflects overall walking conditions in an area. Walkability takes into account the quality of pedestrian facilities, roadway conditions, land use patterns, community support, security and comfort for walking. Walkability can be evaluated at various scales. At a site scale, walkability is affected by the quality of pathways, building accessways and related facilities. At a street or neighborhood level, it is affected by the existence of sidewalks and crosswalks, and roadway conditions (road widths, traffic volumes and speeds). At the community level it is also affected by land use accessibility, such as the relative location of common destinations and the quality of connections between them (TDM Encyclopedia 2013).

Physical Activity: Is defined as any bodily movement produced by skeletal muscles that require energy expenditure (World Health Organization, Physical Activity 2013 para.1).

Objectives and Method

This work aims to investigate the late changes in the built environment that contribute to sedentarization, analyzing the passive environment through a critical approach, pointing the main factors of the problem and its solutions by researching different fields of knowledge. It provides an insight in all the architectural scales, from the urban built environment to the domestic space.

In this way, we can define the following three objectives:

- To find the factors about the phenomenon of sedentarization in the built environment.
- To define the passive environment and its implication in physical and mental health issues.
- To analyze the built environment and provide answers involving human behavior and architectural patterns.

In order to reach these objectives, a research is carried out through a methodology consisting on the critical approach of the current state of the problem supported by research on medical journals and statistics, previous research on active design, active architectural approaches and behavioral sciences. The thesis relates the different perspectives of the different fields of knowledge in order to achieve a synthesis. Through this method it provides clues on the direction that active design may follow and the further steps that need to be taken in order to improve the activity and health of users in the built environment. The researcher believes that the conduction of the present study will provide valuable information to the development of an healthier environment, therefore a positive contribution to society. Besides, the study will improve the understanding in this issue and offer a direction to further research.

Structure

The structure is organized in two parts. The first part is composed by the chapters 1. Introduction and Contextual Approach and the 2. Introductory Facts about Physical Activity, Health and Environment.
The second part constitutes the rest of the chapters and goes from 3. Towards an Active Design to 8 Conclusions.
Chapter 1. Introduction and Contextual Approach helps define the general concepts and is the result of a varied research on the phenomenon of sedentarization, introducing the state of the problem and its main issues. It also describes a brief historical perspective on the manifestations that relate to the body and activity in the built environment and its main precedent events. Chapter 2. Introductory Facts about Physical Activity, Health and the Environment further defines the state of the problem by providing the reader with research data on the health problems that originate from sedentarization and lack of physical activity.
The second part of the study is the intervention. It has the scope of providing answers to the problem exposed before through research on different architectural design concepts and research on activity patterns and behaviors. The study goes from the analysis of large scale and less detailed features of active design, the building and the built environment in general, into its most detailed small scale features, the interior space, the house, and the gym.
Chapter 3. Towards an Active Design introduces the user to active design as the solution to the problem. Chapter 4. Walkability of Space is the result of research on the importance of the walking experience, and constitutes the synthesis of different approaches and solutions that enhance activity through walking, reaffirming the relevance of active design. Having already exposed the general characteristics of active design in the built environment, Chapter 5. Built Environment Elements and Active Design approaches the general elements and features that relate to active design in the context of the built environment. Chapter 6. Interior Space Elements and Active Design is the result of the research found on the interior space and its active potentials under a critical perspective. Chapter 7. Home Active Design approaches active design in the home environment which is complemented with the incorporation of the previous knowledge, this constitutes the final synthesis on the potentials of technologies and active design in the home context.

Introductory Note

As technology prevails in the contemporary space, humans are unaware of the implied side effects of sedentarization and decrease of human movement. With alarming rates of obesity and inactivity related diseases, the mechanized and digitalized space intensifies human passive interaction with the built environment.

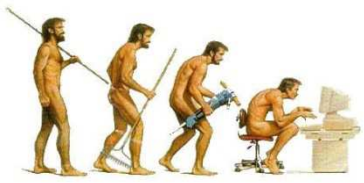
Still, the modern notion of increased comfort and efficiency at the detriment of human health has not yet produced a significant reaction from the design community that insists on approaches that encourage sedentarization and passivity, therefore damaging users health.

For human beings to thrive, the environment should follow an active friendly approach, prioritizing active above passive features. What will be discussed in this thesis is the state and evolution of inactivity in the environment, the eventual active features of the space and the solutions towards an active design.

1. Introduction and Contextual Approach

This chapter draws the context where sedentarization and inactivity take place in the built environment. In the twentieth century, the influence of technologies in human activity were fundamental for the emergence of certain health problems which in turn were related to new spatial configurations, the mechanization of the space. Therefore, it will focus on the link between the technologies and sedentarization, and its relationship with the human activity in the built environment, consisting on a general overview of the problem, and an analysis of its evolution through a brief historical perspective and context approach.

In the twentieth century modern medicine understood the dangers of sitting and lack of physical activity. Modern human activity was largely influenced by technologies such as the car and the elevator, but also influenced by the passivity of the television and ease of communication of the more recent smart phones and internet. These opened the way for an era where the visual sense became the dominant sense and by election the most important to modern humans, which experience their being in the world through it - we behold it from outside as spectators of images projected on the surface of the retina (Pallasmaa, 1996 30). Modernist design has housed the intellect and the eye, but it has left the body and the other senses, as well as our memories and dreams, homeless (Pallasmaa, 1996 16). Humans are increasingly being exposed to a way of life which depends on the absorption of information through the eyes. The human became more of a spectator, living less outside and living more sedentarily as a direct result of this mechanization and digitalization of the space. Yet, it is a matter of public knowledge, that sedentarization leads to physical and mental illness, but not much is being done in order to prevent such issues. This phenomenon of the visual sense predominance is related to sedentarization and reclusiveness, and it is preponderant to understand the built environment problems relating to the inhibition of movement and physical activity.



(Fig. 1) Representation of human evolution and sedentarization.

If physical activity was more encouraged through the design of our cities and home environment, the physiological benefits would be observed in the cardiovascular and musculoskeletal systems, but also affect metabolic, endocrine and immune systems (U.S. Department of Health 17). Psychologically, studies demonstrate that physical activity relieves symptoms of depression and anxiety and improves mood. Higher levels of regular physical activity are also associated with lower mortality rates in all adult age groups.[2] Large amounts of resources would be saved, especially in the medical sectors of our society if we had active approaches to our built environment - which includes all man-made structures, including transportation infrastructure, schools, office buildings, housing and parks (White House 78).

One of the contributors to the passive environment issue, emerged when cities started prioritizing non-human means of transportation which in turn changed the physical experience of individuals and further disconnected them from the direct physical experience with the space. The car became the primary means of transportation, influencing human perceptions and the design of cities - the environment shapes our activity so when the motor vehicle emerged in the city, it became a phenomenon that increasingly affected human activity. The city became highly familiarized and dependent on the automobile. Although this fact is of the knowledge of the general public it seems impossible to remove the automobile from our current lifestyles as that would imply an entire change of the city.

The car and the new technologies of transportation effect of sedentarization was exacerbated by a new optimized approach of the space, the abandonment of previous lifestyles that demanded activity, and the imposition of other new technologies and conventions that simplified life and reduced energy expenditure - since society evolved into the present technological model, physical activities to enhance our health were discouraged (Wells et al. 6-33). These led to the modern quest for comfort and instant gratification which causes a vicious cycle, and is reflected in the passive architectural approach.

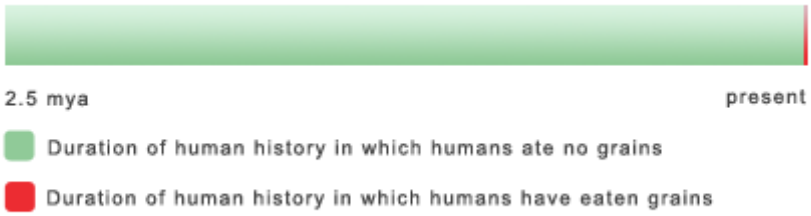
As designers have been educated to develop efficient circulation patterns to enhance productivity, the repercussion of that rationalized and mechanized function is a sedentary environment and less caloric consumption. When humans think of the environment as merely a serving system of passive bodies, it compromises direct physical activity - which is defined as any bodily movement produced by skeletal muscles that require energy expenditure (World Health Organization, Physical Activity, para.1). Innovations have been aimed at making life easier by reducing our energy expenditure and we have strategically engineered physical activity out of our lives (Moreno 399). Modernity optimized plans to minimize travel costs between spaces (Tabor 56-59). These applications often required generalized floor plans and led to standardized views on circulation-based building typologies (Willoughby 59-87). The modern use to maximize utility and minimize the cost (Bloomer and Moore 29). After three thousand years of explosion, by means of fragmentary and mechanical technologies, the Western

world is imploding…Today, after more than a century of electric technology, we have extended our central nervous system itself in a global embrace, abolishing both space and time (McLuhan 3).

These technological and energetic changes led to the sedentarization of human activity. Research found that nowadays, more than 90% of the lives of U.S. citizens are spent in the interior space and this does not include the time in vehicles (Marrero). Human activity is now dependent on the built environment and technology, as if the built environment served as a second body. This building vest and all its sophisticated technological apparatus protect the human body from temperature oscillations and any natural harms - Buildings are tools for making climate. Today, in modern architecture, the human being has a highly-developed climatic instrument. Automatic heat control does not allow the temperatures ... to vary more than a few degrees summer and winter. Cooling systems are combating the excessive temperature of summer. As long as we stay indoors we may have whatever weather suits our whim. The tool by which we turn winter into a perpetual summer is architecture (Bruce 2007 163). Modern humans live inside a protective and artificial vest on the built environment with all the commodities supplemented artificially. This allied with the mechanization and optimization of the space significantly increases comfort at the detriment of the human body caloric expenditure, which further complemented with poor diets based on excess of carbohydrate foods, constitutes the synthesis of the problem of the passive environment which is harmful for human health - architectural and urban design too often support unhealthy rather than healthy lifestyles, and sedentary rather than active daily lifestyles (Burney et al. 6).

If the space is becoming increasingly passive, architects should prioritize the health and activity of the populations in the design. In a world of 400 million obese and 1.6 billion overweight adults, designers, perhaps as much as nutritionists or doctors, have the opportunity to encourage physical activity and in turn, a healthy lifestyle (Stone 1).

There are several studies that demonstrate that the passive environment is also complemented by unhealthy carbohydrate foods readily available and highly advertised, if we consider that carbohydrate rich foods were absent for most of the human evolution (Fallon and Enig; Paleolithic Diet; Mann 1-6; Voegtlin 44-45). Changes in dietary and physical activity patterns are often the result of environmental and societal changes associated with development and lack of supportive policies in sectors such as health, agriculture, transport, urban planning, environment, food processing, distribution, marketing and education (World Health Organization, Obesity and Overweight, para. 17).



(Fig. 2) Carbohydrate food consumption of humans in history.

The previously expressed concern is alluded by Sallis and Glanz: Characterized by environments that promote increased food intake, unhealthy foods and physical inactivity, modern society has become obesogenic (Sallis and Glanz 123–154).

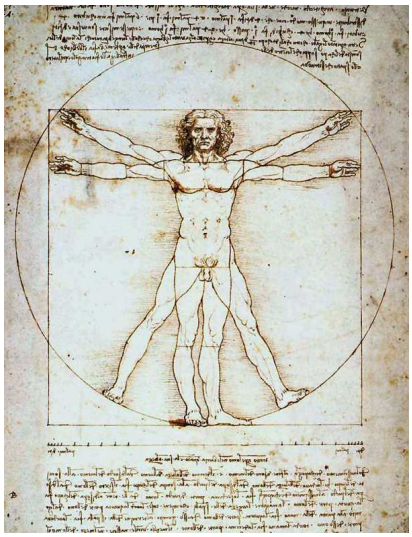
However, despite the health benefits of physical activity, adults do not get enough physical activity, remain completely inactive during their leisure time and do not meet public health recommendations (Ewing et al. 47-57). In order to answer to this problem it is necessary a different approach in the design of human environment, one that prioritizes human activity and health. Physical activity interventions are likely to have positive side effects for a range of health-related behaviors and conditions (King and Sallis 1). The design of residences, developments and supporting transportation infrastructure should be encouraged to provide more active friendly environments (Transportation Research Board 232).

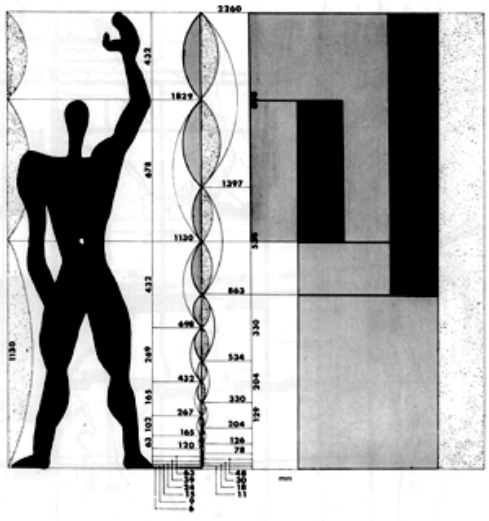
1.1 The Visual Sense and the Digitalization of the Space

The passive environment is not a recent condition. It has been gradually evolving along with the modern technologies for one century now. Since the mass implementation of the car as the primary means of transportation alongside with the emergence of the mechanized, optimized, and digitalized space - Building construction practices during the past 100 years, along with a wide range of technological developments may have contributed to the obesity epidemic by enabling us to expend less energy to accomplish tasks (Wells, 6-33). These approaches to the space were supported by the fact already discussed that the tactile sense was completely overpowered by the visual sense. The space that before responded primarily to the tactile sense and other bodily senses became increasingly more related to the visual sense, the image - The current over-emphasis on the intellectual and conceptual dimensions of architecture further contributes to a disappearance of the physical, sensual and embodied essence of architecture (Pallasmaa, 2006, 29). Additionally, it is important to state that in the modern world, human bodies were not only influenced by the urban car phenomenon, humans entered the age of communication, where to travel and access information it is only necessary a laptop, this is the scenario of the immense relevance of the image and the visual sense in the contemporary age through the digitalization of the space.

The digitalization of the space is the final blow on the tactile sense, completely eradicating from the daily life of the individual the need to move in order to access information and entertainment. This might not seem an important issue, for the many benefits of technologies, that surely outweigh the disadvantages, but when put into perspective, the relation of the human with the space was always fully corporal and primarily tactile. Bloomer and Moore has expressed this concern: In the beggining, all architecture emerged from the sense of space with the body as reference (Bloomer and Moore 16). Humans always adapted the environment and the buildings to correspond to the human body in its tactile and moving form. The following statement of Pallasmaa also alludes to this notion: The primitive man used his body as the dimensioning and proportioning system of his constructions. The builders of traditional societies shaped these buildings with their own bodies in the same way that a bird molds its nest by its body. The essential knowledge of the ancient hunter, fisherman and farmer, as well as of the mason and stone cutter, was an imitation of an embodied tradition of the trade, stored in the muscular and tactile senses (Pallasmaa, 2006, 34). The old anthropomorphic idea of the *genius loci* was a recognition of this phenomenon (Dodds and Tavernor 305). Building structures are unconsciously imitated and comprehended through the skeletal system unknowingly, as we perform the task of the column or the vault with our body (Pallasmaa 2006, 36). This constitutes an evolution of thought in the design of our environment in accordance to our body functions and dynamics, defining the human as a corporeal being and architecture as a corporeal art - As for architecture and design are definitely corporeal arts, and humans are essentially corporeal. We always project a corporeal state conforming to our own; we interpret the whole outside world according to the expressive system

with which we have become familiar through our own bodies ... In the processes of unconscious endowment of animation, art of corporeal masses, relates to the human being as a corporeal being (Vidler 72-73). An architect internalizes a building in his body; movement, balance, distance and scale are felt unconsciously through the body as tension in the muscular system and in the positions of the skeleton and inner organs. As the work interacts with the body of the observer the experience mirrors these bodily sensations of the maker. Consequently, architecture is a communication from the body of the architect directly to the body of the inhabitant (Pallasmaa, 2006, 36). The body, if it figures into architectural theory at all, is often reduced to an aggregate of needs and constraints which are to be accommodated by methods of design grounded in behavioral and ergonomic analysis (Dodds and Tavernor 304). From this perspective this study assumes that the predominance of the visual sense over the architectural tactile sense is a characteristic circumstance of the modern society and constitutes a relatively recent phenomenon which is related to the mediatization and mechanization of the space. Architecture evolved in correlation with the body, therefore, it should be responsive to all the senses of the human body, including the tactile sense and kinesthesia (Bloomer and Moore 1982).





(Fig. 3) (Fig. 4) Vitruvian Man and Le Corbusier Modulor.

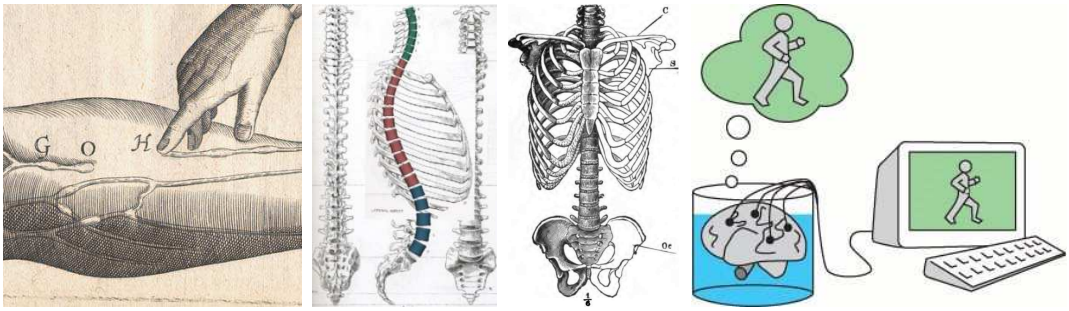
1.2 A Brief Historical Perspective on the Body and the Space

The fact that the body had an enormous influence on the evolution of architectural design should be recognized in the present era, especially when we think of the body as a structure designed for movement and activity. In the book Flesh and Stone, Richard Sennett describes the history of architecture and urbanism through the perspective of the stone as a product of the flesh, and the flesh shaped by the stone, in other words, architecture as a product of the body. There were several episodes in history where discoveries in the anatomic area served to challenge certain dogmas of architecture - Harvey's *De motu cordis* in the early seventeenth century, is a scientific work which radically altered the understanding of circulation in the body; this new image of the body as a circulating system prompted eighteenth-century attempts to circulate bodies freely in the city (Sennett 22). Cities in the past possessed unhealthy conditions related to the lack of ventilation and poor means of circulation. A problem that improved with the incorporated discoveries on the body system of circulation and ventilation in the urban design and architecture. In the contemporary age, it became clear that the human body was not made to be static. It rather evolved on thousands of years of adaptation to live in action. In the modern age, emerged a notion of architecture for the body as a passive organism, however, if the body is an organism that evolved in correlation to an active or even hostile environment, how can it thrive in a passive environment.

The fact that the human body did not change significantly in the last 10000 years, remaining an outdated organism for the present environment is expressed in the following statement: Human bodies adapt to the external environment, as it is commonly known, however we are heirs of inherited characteristics that occurred over millions of years; the vast majority of our biochemistry and physiology are tuned to life conditions that existed before the advent of agriculture. Genetically our bodies are virtually the same as they were at the end of the Paleolithic era some 20,000 years ago. Humans arose through a multimillion year evolutionary process during nearly all of which genetic change reflected the life circumstances of our ancestral species. Since the appearance of agriculture 10000 years ago and especially since the Industrial Revolution, genetic adaptation has been unable to keep pace with cultural progress (Tooby and Cosimides, 1990). Natural selection has produced only minor alterations during the past 10000 years, so our bodies remain nearly identical to our late Paleolithic ancestors (Tooby and Cosimides, 1990; Eaton and Konner, 1997, 207; Eaton, 2003, 153-159).

Although adaptive, the body is still in much need of constant activity and it will react negatively to a passive environment. The opposing concept, that the human body will also adapt this technological and passive environment, is invalid, as for that effect would mean a long time span of evolution and the final result could eventually mean the extinction of the active human body, see (fig.8). The body was programmed to absorb as much calories as possible, and to expend them shortly after. Logically, we can assume that the modern bodies are still functioning identically to the hunter-collector bodies of

the human primitive ancestors. Although constantly evolving, the human body is currently an outdated design for another environment other than the present cities and buildings. The effects of such environment might prove to be detrimental to human health, specially when the architecture that prioritized an approach of the body in the building is being eclipsed by a technological approach. This notion is in part supported by Vidler: The idea of an architecture as an embodiment and abstract representation of the human body (...) was, we are led to believe, abandoned with the collapse of the classical tradition and the birth of a technologically dependent architecture (Vidler 69).



(Fig. 5) Harvey de Motu Cordis. Detail from plate 1: Harvey performs a simple experiment - using a ligature to extend the veins in the arm he shows that blood can only be moved along the veins in one direction hence proving the existence of one-way valves in the veins.

(Fig. 6) (Fig. 7) Human skeleton with curvilinear shaped bone structure due to evolution on an active environment.

(Fig. 8) Utopian concept of brain in a vat, in which humans could hypothetically live through an artificial and simulated environment without the need of a body. In such concept humans would not need clothes nor houses and would live through a virtual platform - this an example of manipulation of the human body, its capacity and initiative, meaning its absolute passivity. The body would be expelled from its existence and the world starts depending on certain sensations stimulated by artificial systems (Bloomer and Moore 86-87).

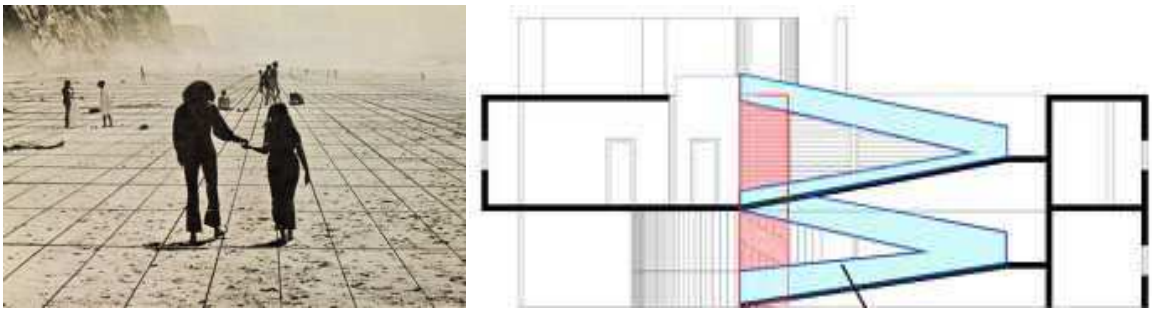
1.3 XX Century Facts and Manifestations that Relate to the Body

Following the line of thought of the previous chapters, it is undeniable that humans are constantly interacting with the built environment and this shapes the human health but also human identity. We are in constant dialogue with the environment, to the degree that it is impossible to detach the image of the self from its spatial and situational existence (Pallasmaa, 2006, 35). We behold, touch, listen and measure the world with our entire bodily existence and the experiential world is organized and articulated around the center of the body (Pallasmaa, 2006, 35).

Several architectural related manifestations were triggered by technological innovations that relate to the body. The futurists were known for their enthusiasm with the motor vehicle, movement and dynamic forms. Futurism had a very peculiar and revolutionary perspective on life, affirming the victories of the technological innovations in its aesthetics and theory. At the time, futurism was in fact a diverging movement but rather naive in the assumption that technology was the solution for society's problems. Their theory was inherently progressive but lacked the contemporary experience on how technologies can become oppressive on the human body. Yet, the essence of the futurism lies on a certain quest for movement and activity. There are inherent suggestions that praise action and energy in the futurist theory, as research has found in the following quote of the futurist manifesto: "We want to sing the love of danger, the habit of energy and rashness. The essential elements of our poetry will be courage, audacity and revolt." However their ideas often referred to technologies such as the car, we can assume that the futurists were not aware of the health condition and passive environment those technologies could imply.

The later modern concepts of the house as a machine of Le Corbusier, and his city plans that integrated the car and the train, followed an approach that was intertwined with technology. The following quote expresses Le Corbusier mechanized and technological approach with a touch of futurism: If we eliminate from our hearts and minds all dead concepts in regard to the house … we shall arrive at the "house-machine", the mass-production house, healthy (and morally too) and beautiful in the same way that working tools and instruments that accompany our existence are beautiful (Corbusier 254).

Villa Savoye attempts to resemble a machine, not only by its contrasting white surface in the green background but for its floating appearance. Villa Savoye presents the occupant with an almost cinematographic experience with its paths and ramps which are to be considered as a positive feature of environmental activity, however mechanized activity, these paths are a reference to the video technology along with the screen perspectives in the rooftop which suggest photographs of the landscape. Also, the house is located in an isolated site in the outskirts of Paris, in a location of unfavorable access if not by car. In essence, the modern house started a slow process of assimilation of activities that were reserved to the outside and urban space, because of the growing availability of technologies such as home appliances that made the home environment more autonomous.



(Fig. 9) Supestudio. Futuristic uthopian concept. A platform where humans can obtain information, food and energy.

(Fig. 10) Le Corbusier Villa Savoye ramps.

(Fig. 11) Le Corbusier Villa Savoye. A machine for living.

The innovative city plans of Le Corbusier would revolutionize the concept of city. Both *Ville Radieuse* and *Ville Contemporaine* were designed having in mind the car and new means of transportation based on the motor vehicle. The Ville Radieuse with its isolated sections could only be functional with the car or a motorized means of transportation. The *Ville Contemporaine* often ignored or segregated human circulation.

Later, in the 50's it started the widespread use of the ludic house that was equipped with several appliances such as the fridge, the television and the radio. This mechanization and later the intense digitalization of the house, gradually developed into a harmful passive environment. Vidler has expressed this concern in the following statement: Where in the taylorized settings of the twenties and thirties, the home was to be retooled to produce a generation of engineers and technocrats, the woman smoothly integrating time and motion into the carefully calculated spaces of a "kitchen-house-factory", now the space of technological competency is reduced to the flat surface of the monitor … a "machine for living in" has been transformed into a potentially dangerous psychopathological space

populated by half-natural, half-prosthetic individuals, where walls reflect the sight of their viewers, where the house surveys its occupants with silent menace (Vidler 161).

(Fig. 12) Ville Radieuse plan with its isolated sections.

(Fig. 13) Villa Savoye walking spaces.

(Fig. 14) House of the 50's appliances.

The problem of the early omnipresence of technologies was partially detected by the situationist international whom - argued that although the economic and technological achievements of capitalism, society is in some sense alienated from itself (Plant 1-21). Furthermore they considered the mediatization of society one of the causes of alienation of the individual, supporting the concept of this thesis that technologies can increase the passivity of the environment. They referred to this phenomenon the society of the spectacle - the society of the spectacle is a society asleep, in hibernation or a state of suspended animation, for which ideology is no longer a historical choice, but simply an assertion of the obvious (Debord, 1991, 10). This absolute realization of commodity relations produces an entirely inverted world, in which everything that was directly lived has become mere representation, a dull reflection of itself. (Debord, 1991, 4-12).

Another concept of the situationists was psychogeography's principle *dérive*. Long a favourite practice of the dadaists, who organised a variety of expeditions, and the surrealists, for whom the geographical form of automatism was an instructive pleasure, the dérive, or drift, was defined by the situationists as the technique of locomotion without a goal. (Vaneigem 85; Plant 58). This was a clear intention to rebel against the standardization and restriction of movement in the cities, and an attempt to generate

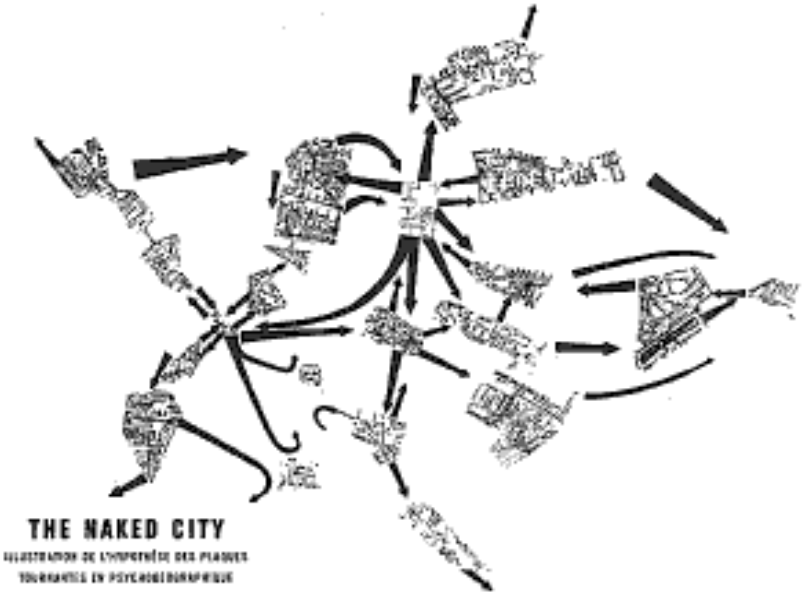
free actions and movement - The progress of psychogeography depends to a great extent on the statistical extension of its methods of observation, but above all on the experimentation by means of concrete interventions in urbanism (Hill, 2003, 66).

The situationists opposed the alienation of the human activity specially regarding the television and the perception of the world through the visual sense, advocating a direct physical experience in the space as the solution to the problems in society. Trought the construction of situations and the direct interaction with the space, the situationists thought, one would find the liberation of everyday life, the part of experience that was omitted from the history books. This concern was expressed throughout The Situationist International (Debord 2002, 14, 321). The liberation from the spectacle, which refers to the simulation of life based on technological apparatus.

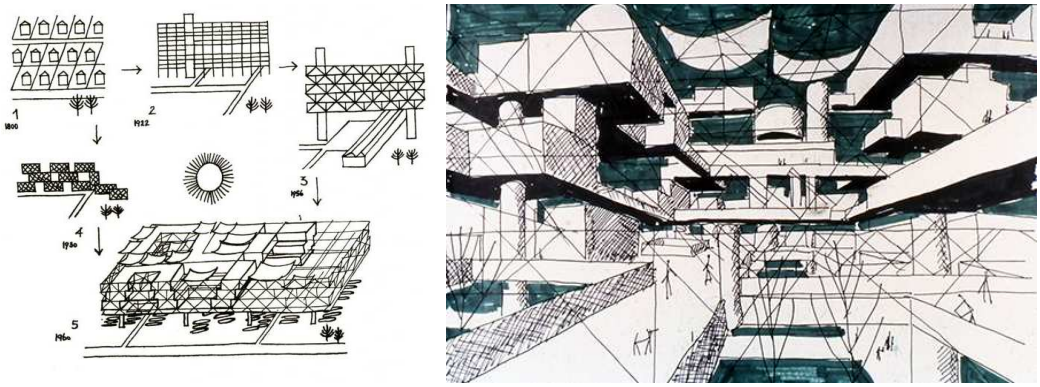
The situationist concept of psychogeography is related to this study because it supports the concept of human health and wellbeing concercing human direct experience and activity in the space - Psychogeography is an approach to geography that emphasizes playfulness and "drifting" around urban environments. Psychogeography was defined by Guy Debord as the study of the precise laws and specific effects of the geographical environment, consciously organized or not, on the emotions and behavior of individuals (Debord, Introduction to a Critique of Urban Geography) A whole toy box full of playful, inventive strategies for exploring cities ... just about anything that takes pedestrians off their predictable paths and jolts them into a new awareness of the urban landscape (Hart, para.1).

Unitary Urbanism - the synthesis of art and technology that we call for — must be constructed according to certain new values of life, values which now need to be distinguished and disseminated (Wolman, para.11) It demanded the rejection of functional, Euclidean values in architecture, as well as the separation between art and its surroundings (Wikipedia, para.2). Therefore according to the situationists, the individual should be in power to create his own spatial activity, and escape the laws and dogmas of the space. This notion further evolved into radical views considering the space as an element of oppression which had its influence on the May 1968 protests. Raoul Vaneigem wrote in the manifesto of unitary urbanism: All space is occupied by the enemy. We are living under a permanent curfew. Not just the cops — the geometry (Gray 26). Or the following quotes of Debord reflecting the condition of the modern society in which authentic social life has been replaced with its representation: All that once was directly lived has become mere representation (Debord, 1994, thesis 1). Debord summed it up this way: The first phase of the domination of the economy over social life brought into the definition of all human realization the obvious degradation of being into having. The present phase of total occupation of social life by the accumulated results of the economy, by spectacle, leads to a generalized sliding of having into appearing. (Debord 2002, 10) We are twice removed from where we want to be, the situationists argued, yet each day still seems like a natural fact. The decline of being into having, and having into merely appearing. Passive identification with the spectacle supplants genuine activity. The spectacle is not a collection of images, rather, it is a social relationship between people that is mediated by images (Debord, 1994, thesis 4). All that was once directly lived has

become mere representation. Referring to the overwhelming importance of the image in contemporary society. Images, Debord says, have supplanted genuine human interaction (Debord, 1994, thesis 1). The spectator has been drugged by spectacular images, a sense of self-consciousness of existence within a particular environment or ambience (Ford 50). This notion of the image and the visual sense achieving the primordial status in the modern society also discussed in the work of Michel Foucault is one of the contributors to sedentarization and lack of physical activity and will be further discussed ahead.



(Fig. 15) Representation of the situationist city.



(Fig. 16) (Fig. 17) Yona Friedman Mobile Architecture concept. An approach that shares the same theory in this thesis envisioning the city with free circulation paths, where the space prioritizes the walking experience of the human body and places the buildings floating in second plane so that it occupies less space.

The situationist maps described an urban navigational system that operated independently of Paris dominant patterns of circulation (The situationist city, para.3.) Conventional cities have a psychogeographical relief, with constant currents, fixed points and vortexes which strongly discourage entry into or exit from certain zones (Knabb 50).

In the 70's-80's a phenomenon known as culture jamming appeared as a counter-culture. Linked with several other movements in which part of their argument was to reclaim the public space back to the human activity and the opposition to the conventional laws of society. The following quote of Berman alludes to this: At the ragged edge of Baudelaire's imagination we glimpsed another potential modernism: revolutionary protest that transforms a multitude of urban solitudes into a people, and reclaims the city streets for human life (Berman 166-177). Also related to this concern, the urban art movements, aim to certain elements of the urban fabric as obstacles with the intention of perhaps reclaiming the space. These movements as well as vandalism are related to the spatial configurations of the city and the house.[1] The urban art movements are related to post-modernism for its objective of causing a reaction on the public. These are interesting to be mentioned not only for their intervention in the urban fabric but also for being action oriented manifestations.

Although, action painting concept was first invented by Jackson Pollock where his works were a continuous production, with great emphasis on the action, the urban art movements had also the concept of activity and action, but also embracing the concepts of time and place. Although controversial, this phenomenon can be interpreted as a reaction from the youth to the already present sedentarization and other symptoms related to the mediatization of society and alienation of the individual.

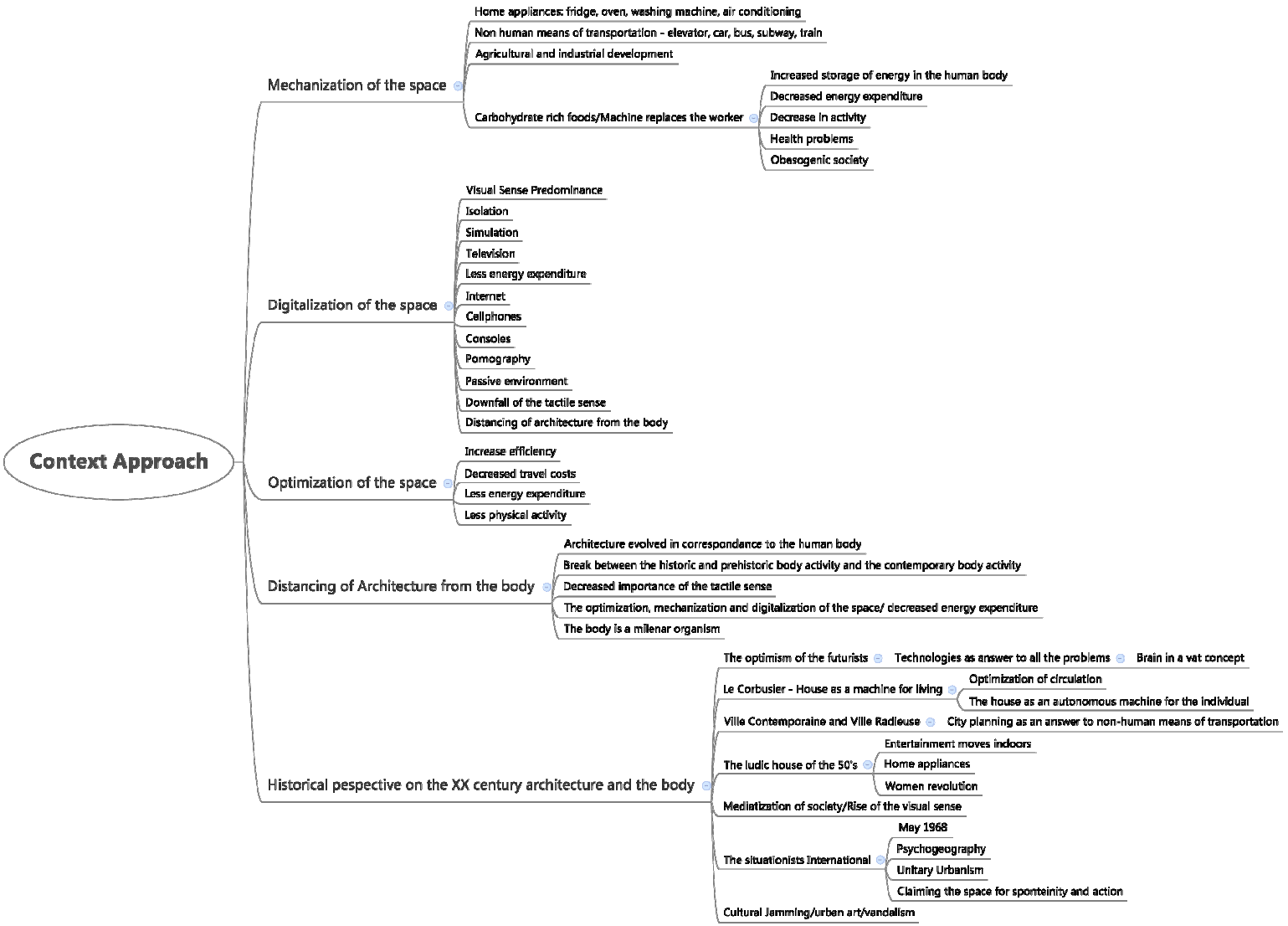
A more recent phenomenon, the parcour, in which the human body interacts with the urban environment which is perceived with its obstacles and elements that are part of an active itinerary. Following this discourse of activity-oriented spaces through the priority of circulation and the walking path, the architecture of Bernard Tschumi puts much emphasis on active friendly environments. Tschumi active circulation systems and his "events spaces" will be further discussed on this study.

This part of the study serves to realize the extreme importance of activity oriented approaches in the contemporary age and the urgency of the problem.

[1] Vandalism is related to such factors as inadequate playspaces, lack of youth clubs ,sports and entertainment facilities (...) As a result, it is suggested, the young people in question are 'bored', and become involved in vandalism as a consequence (Lévy-Leboyer 134).

(Fig. 18) (Fig. 19) (Fig. 20) Parcour as an interaction with the built environment.

The visual sense has achieved more relevance in the contemporary age becoming one of the factors that contributes to the sedentarization of space and the oblivion of the tactile sense. However society constantly reacted to this passive environment, human beings seemed to finally have adapted the unnatural ways of the digitalized and mechanized space for comfort and convenience. Though, this spatial configuration became more functional, it did not necessarily became more active and productive at the long term and this reflected in the mental and physical health statistics of the populations. If the relation between the human body and design was a constant in our history, designers should now update their concepts of space having in consideration body movement and human activity in order to respond to these issues.


Context Approach
Mechanization of the space
Home appliances: fridge, oven, washing machine, air conditioning
Non human means of transportation - elevator, car, bus, subway, train
Agricultural and industrial development
Carbohydrate rich foods/Machine replaces the worker
Increased storage of energy in the human body
Decreased energy expenditure
Decrease in activity
Health problems
Obesogenic society
Digitalization of the space
Visual Sense Predominance
Isolation
Simulation
Television
Less energy expenditure
Internet
Cellphones
Consoles
Pornography
Passive environment
Downfall of the tactile sense
Distancing of architecture from the body
Optimization of the space
Increase efficiency
Decreased travel costs
Less energy expenditure
Less physical activity
Distancing of Architecture from the body
Architecture evolved in correspondance to the human body
Break between the historic and prehistoric body activity and the contemporary body activity
Decreased importance of the tactile sense
The optimization, mechanization and digitalization of the space/ decreased energy expenditure
The body is a milenar organism
Historical pespective on the XX century architecture and the body
The optimism of the futurists
Technologies as answer to all the problems
Brain in a vat concept
Le Corbusier - House as a machine for living
Optimization of circulation
The house as an autonomous machine for the individual
Ville Contemporaine and Ville Radieuse
City planning as an answer to non-human means of transportation
The ludic house of the 50's
Entertainment moves indoors
Home appliances
Women revolution
Mediatization of society/Rise of the visual sense
The situationists International
May 1968
Psychogeography
Unitary Urbanism
Claiming the space for sponteinity and action
Cultural Jamming/urban art/vandalism

2. Introductory Facts about Physical Activity, Health and the Environment

Globally, in 2010 the number of overweight children under the age of five is estimated to be over 42 million. Close to 35 million of these are living in developing countries (WHO, Global strategy on diet 2004, para.1). Spain is not an exception, according to the World Health Organization, Spain is one of the countries in the EU with the greatest prevalence of overweight (and obese) children. In addition, Spain is one of the countries where this condition has increased more substantially (García and Quevedo 22; Valera and Silvestre 2009) (See fig.17). In 2008, more than 1.4 billion adults, 20 and older, were overweight. Of these overweight adults, over 200 million men and nearly 300 million women were obese. Overall, more than 10% of the world's adult population was obese. More than 40 million children under the age of five were overweight in 2011 (WHO, Obesity and Overweight 2013). Overweight and obese children are likely to stay obese into adulthood and more likely to develop non-communicable diseases like diabetes and cardiovascular diseases at a younger age. The prevention of childhood obesity needs high priority (WHO, Global strategy on diet 2013, para.1). Nearly one third of youth are insufficiently active, and more than half of all youth fall far short of recommended levels of vigorous activity[2] (Krizeck, Birnbaum and Levinson 33-38). Physical activity should be more encouraged as it reduces risk for cardiovascular diseases and diabetes and has substantial benefits for many conditions, not only those associated with obesity (WHO, Global strategy on diet, 4).

Lower socioeconomic status (SES) has been consistently associated with poorer health in childhood (Starfield, Robertson and Riley 238-46). Childhood socioeconomic circumstances also shape adult disease risks and explain in part the origins of adult health disparities. As with many other aspects of health, children in lower SES households are more likely to be overweight or obese (Delva, O'Malley, and Johnston 536–45). This condition is often worse for people with lower incomes and less education, and for racial and ethnic minorities, who often have more limited access to affordable foods and safe, accessible places to be active (Levi, et al. 3). The lower income communities neglect physical activity for their decreased access to spaces for the effect, as well as their economical status difficult any investments to enhance active policies.

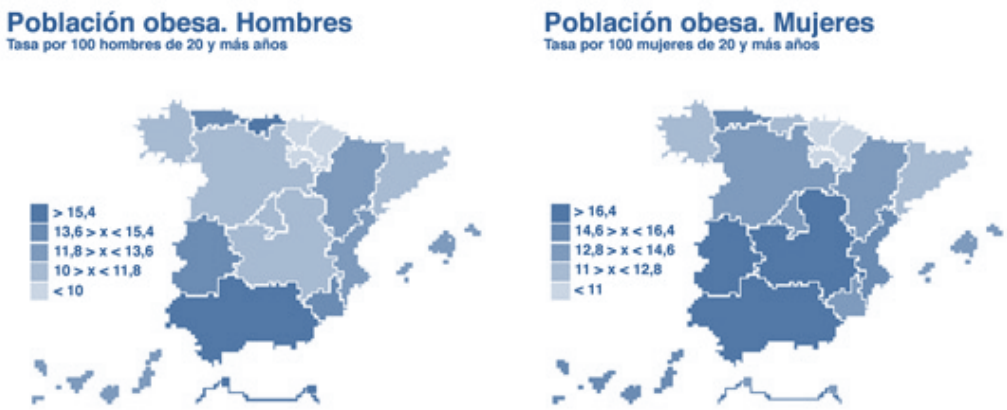
The built environment has been thought to play an important role in influencing obesity by creating a climate that promotes increased energy consumption and a reduction in energy expenditure (Papas et al. 129; Addy et al. 440-43; Wells et al. 14) There is growing interest in how physical inactivity, obesity, and related chronic health problems are affected by environmental factors. (Ewing 47-57; O'Keefe para.19). Any form of physical interaction in the built environment should be encouraged and activated by design instead of promoting passive strategies.

Understanding the built environment influence on the physical health and activity of modern humans is preponderant to define strategies both in the social environment and in the design of our built

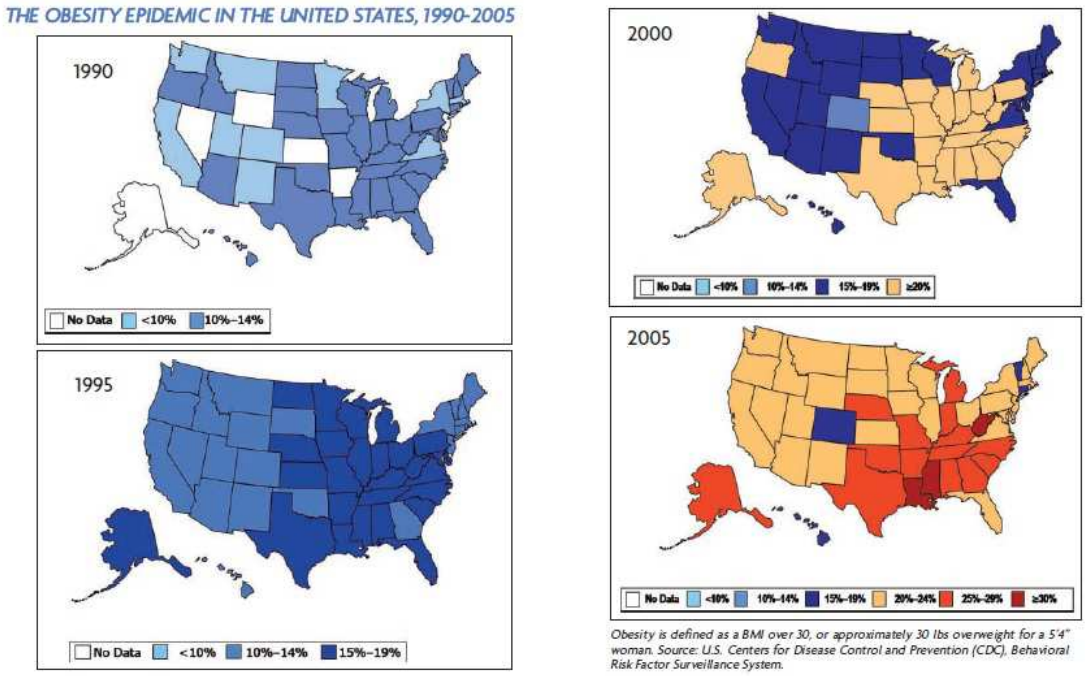
[2] In the U.S.A.

environment. Architects should be aware of these problems so that further research and further measures will be taken to ensure the built environment can be improved to generate activity. Education plays a major role, as can be attested on the past decades with the evolution of sustainable architecture and design. A social ecological perspective of health suggests that both social and environmental factors play an important role in increasing physical activity (Addy et al. 440). Teaching the population about active environments could produce a generation of advocates for healthy community environments (Sallis and Glanz 123–54).

Also, the access to media and education are two important factors that influence how humans interact with the environment. If a child is brought up on an environment where sedentary behaviors are encouraged, that alone, is enough to substantially decrease the physical activity of the child. On this concern research found that - if the hours spent on internet and television were in part replaced by physically active playing, that alone would increase physical activity and health of individuals - factors such as access to media, parenting practices, sibling influences, and family habits, may be important influences on children's sedentary and active behaviors (Jago et al. 572-78).



(Fig. 21) Obesity in Spain, (2010, Minsterio Sanidad).



(Fig. 22) Obesity Epidemic in the United States.

It is now clear that even the economical status is influential on the development of active strategies in the communities, as the healthy habits of physical activity are not seen as a priority due to their low income, the whole communities are left isolated from the concept of a active environment. The neighborhood also influences the child physical activity, not only the built environment, therefore, the relationship of the individual with the community will influence his activity. This is relative factor, but the fact is, the wealthier families are, the more they have the possibility to afford gyms and sports, as well as, improved quality nutrition (Jago et al. 572-78). The availability of physical activity facilities will increase the health of the communities since - individuals are more likely to engage in physical activity if it is provided for them in close proximity to where they live (Addy et al. 443). Aspects may include urban design factors, land use, and available public transportation, as well as the available activity options for people within that space (Booth, Pinkston, and Poston 3). Design and environmental systems that promotes walking and physical activity will help create active, healthier, and more livable communities (Handy 73). Communities should be encouraged to provide opportunities for healthy lifestyle choices in all childhood settings before, during and after school, as well as on weekends and holidays (White House 67).

2.1 Further Data on Health and the Active Design Purpose

The main goal is consistently improve the health and activity of the populations, for its benefits are countless. Regular physical activity improves both physiological and psychological health. Physiological benefits are observed in cardiovascular and musculoskeletal systems, but also affect metabolic, endocrine and immune systems. Psychologically, studies demonstrate that physical activity relieves symptoms of depression and anxiety and improves mood. Higher levels of regular physical activity are also associated with lower mortality rates in all adult age groups (U.S. Department of Health 14). It is important to note that, physical activity comprises all the human body movement, whether it is slow, moderate or intense activity.

The general strategies that can be adopted to improve the activity and health of a community are many, but very relative when considering its effective results. The irony is that although much of urban planning policy is rooted in a concern for public health, the ultimate result has contributed to major contemporary health problems related to inactivity and obesity. (Wells, et al. 19). This concern is also express in the following statement: Although we were presented with an exponential development in the areas of urban planning, a the World Health Organization, worldwide obesity has doubled since 1980 (WHO, Obesity and Overweight, para.1). Overweight and obesity are the fifth leading risk for global deaths. At least 2.8 million adults die each year as a result of being overweight or obese. In addition, 44% of the diabetes burden, 23% of the ischaemic heart disease burden and between 7% and 41% of certain cancer burdens are attributable to overweight and obesity (WHO, Obesity and Overweight). Obesity is a complex condition, one with serious social and psychological dimensions, that affects virtually all age and socioeconomic groups and threatens to overwhelm both developed and developing countries (WHO, Controlling the Global Obesity Epidemic para.2). Also, other than socioeconomic and environmental factors as reffered previously, lifestyle preferences, and cultural environment play pivotal roles in the rising prevalence of obesity worldwide (Dehghan, Akhtar-Danesh, and Merchant 5). Globally there has been an increase in intake of energy dense foods that are high in fat, salt and sugar, but low in vitamins, minerals and other micronutrients (WHO, Global Strategy on Diet para.3). Therefore, obesity is related to the environment, SES, education and nutrition.

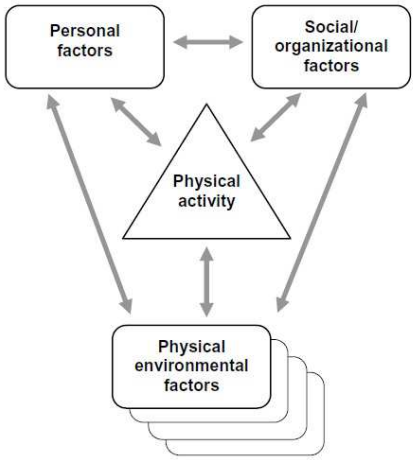
At first glance, several simple strategies can be approached in order to enhance activity in the built environment. Research found that by slightly improving the walkability of the space, the design is contributing to the general health of the population. Many authors support the concept of the workplace as a base for walking trips in urban settings (Wegman and Jang 264-70; Zimring, 2005, 188). This would mean the adoption of an approach which promotes walking in the interior space, for instance, through the study of the paths and distances between spaces. Also, we must have in account, that people will walk more if they have destinations such as transit, shopping, eating, or home within 0.25 miles to 0.5 miles from their workplace (Vuori, Oja, and Paronen 844 –50). And, trip-linkage patterns showed that the highest percentage of non–work activity trips made via walking were

before, during, and after work, and that work was second only to home as a base for activity trips (Wegman and Jang 264-70).

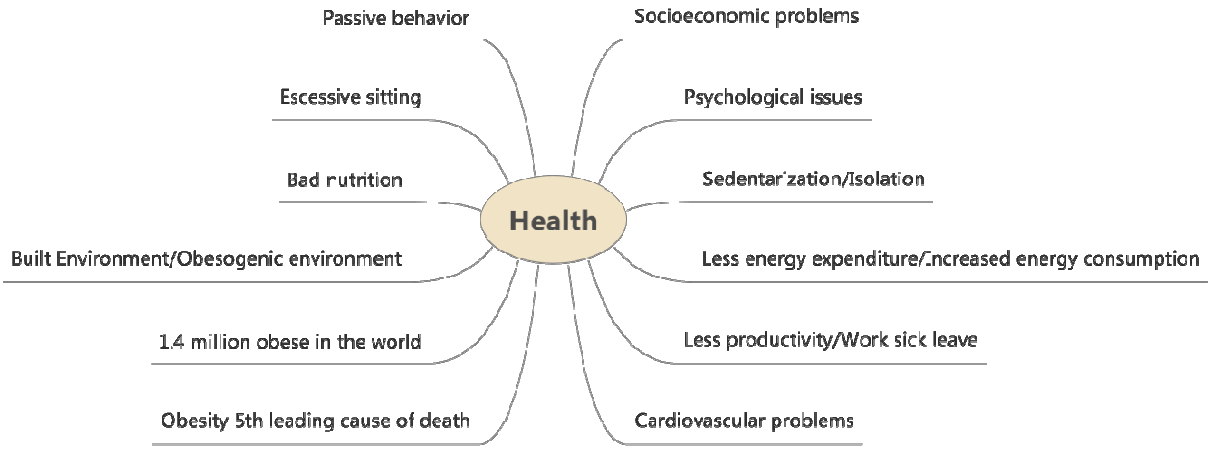
Additionally, research found that other passive approaches to promote physical activity include restricting downtown centers to foot or bicycle traffic, placing parking lots on a suitable distance from buildings, making stairways more appealing and user friendly, planning new communities with businesses and schools built adjacent to residential areas and connected by a network of bicycling and walking paths, as well as public transportation (Mansi, et al. 610-14). However, it is important to note tha a suitable distance does not mean close, neither it means extremely far. In addition, amenities designed specifically to promote physical activity, such as walking/jogging paths and par courses, have been implemented at several public facilities and reported as successful in a survey of state agencies (Zimring, et al. 2005, 189). A UK study highlighted the importance of having boundaries between private and shared space with features such as shared recreational space, multiple access and fewer private gardens being associated with higher levels of depression (Weich et al. 283-292) Not intending to go in detail, the previously stated examples are introductory and serve to conclude that an environment can and should promote physical activity, and therefore have the fundamental means of improving the physical and mental health of individuals (WHO, Global Strategy on Diet, 3).

The main aim of this thesis is to scrutinize what are the traits of an active space that could increase activity, through the research of what motivates it and also, what can be done to avoid passive environments through a perspective of prevention in design.

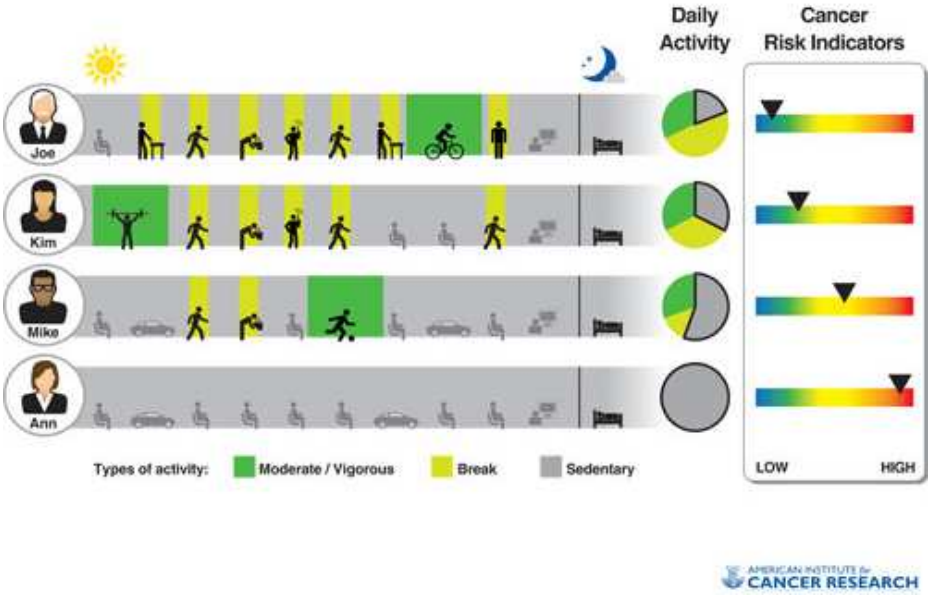
Despite important advances in the research of this subject, obesity remains one of the biggest public health challenges (Levi et al. 3). The challenge is to better understand the broad impact of our built environment on health and then design and build future environments and perhaps re-design existing environments that promote physical and mental health. It is time for a shift to built environments intentionally designed to facilitate physical and mental well-being (Jackson, 2003. 1382-84).



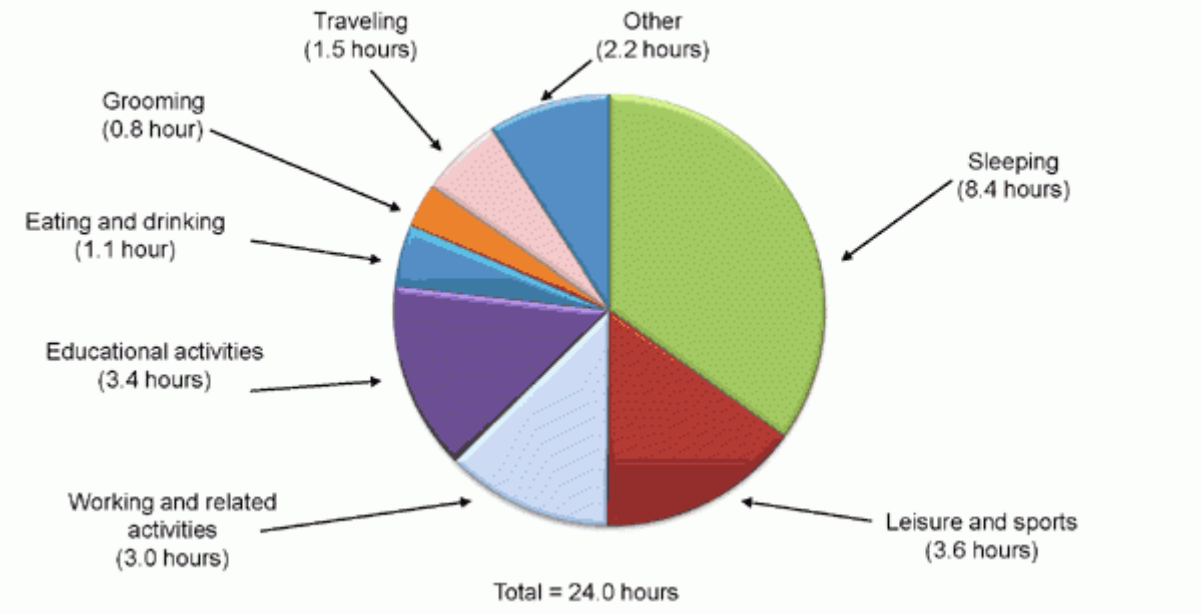
(Fig. 23) A social ecologic model of influences on physical activity.



(Fig. 24) Health factors synthesis.



(Fig. 25) Relationship of sedentarization and cancer.



(Fig. 26) Average time spent watching television. Data includes individuals, ages 15 to 49. 2010.

3. Towards an Active Design

Although the capacity of movement of the human being may be considered unlimited, the fact is that the majority are reduced to a number of possibilities that configure the experience of movement. In this sense, the strongest constraint is precisely our surrounding built environment: the spaces and objects that we built ourselves (Bloomer and Moore 72).

In the XX century, a variety of technologies innovated and influenced all the sectors of society. The modern society became more sedentary, less outgoing, increasingly conformed to passive sources of entertainment and information, and gradually internalized entertainment and leisure indoors - Modernism started in part the practice of the long-standing utopian tradition of leisure at the centre of life and this was certainly associated with the aims of the Modern Movement (Bruce 30). The rise of a culture and architecture that valued entertainment allied with the passive technologies, were the main ingredients for the interior space leisure and mediatization phenomenon, that yet has made the human being less physically active and consequently more unhealthy. The comfort enhancing technologies and functional spatial strategies that reduce movement and caloric expenditure are proven to be another of the causes of inactivity and therefore obesity. Can architects provide any design solutions to this problem?

Technologies such as the television, the telephone and the internet were originally created to simplify human life. The result was the improvement of human comfort by rationalizing entertainment and making communication more instant, less time consuming, and minimizing human energy expenditure. This technological revolution along with the new spatial configuration of housing opened the way for a new human body interaction with the space as the following statement of Wells alludes: During the past 100 years, building construction practices along with a wide range of technological developments may have contributed to the obesity epidemic by enabling us to expend less energy (Wells, et al. 17). Although these modern technologies were not originally the source of the problem, as they were designed to improve human productivity, society was not aware that the optimization and mechanization of the space would reduce physical activity and affect individuals health. The concept now fully understood, that buildings are a body envelope that have an enormous influence on individuals behavior and daily activity is also suggested by Zimring: Since individuals and groups use buildings on a daily basis, they are affected by the built-in physical aspects of the building and site (Zimring et al. 2005, 187).

Therefore, the optimization of the space is one of the main contributors to the decreased human energy expenditure, though this is often seen as a sign of progress, as the space evolved in the past century with innovative appliances and optimized space standards, efficiency and functionality improved, however it hides the true reality of the problem, it reduces and standardizes human movement. The following statements support this notion: interior spatial functions have changed

dramatically over the past century (Ward 41), with the incorporation of automated appliances, computers at home and design standards for efficiency (Sallis and Glanz 123-54). These space standards were imposed for purposes of efficiency and functionality (Chilton and Baldry 187-94) creating a climate that promotes increased energy consumption and a reduction in energy expenditure (Papas et al. 129; Addy et al. 440-43; Wells et al. 14).

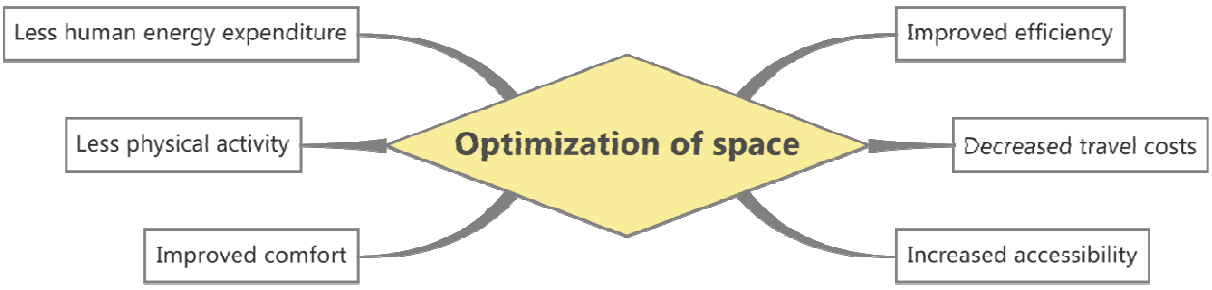
Allied with new technologies, this phenomenon brought a new spatial criteria that standardized and simplified movement, therefore reducing physical activity. The spatial configuration of buildings improved at the expense of a decreased human movement - we spend much of our time at the computer. We send e-mails rather than walk to a colleague‘s office, and we roll across the room rather than stand to retrieve a book (Wells et al. 15). Humans are travelling faster than in the past, however the movement experienced is fundamentally passive and lacking activity when compared to other moments of human history. The authentic movement is being replaced for the "frozen movement" (Bloomer and Moore 84-85).

The concept of functional modern home, as well as the overuse of non human-powered means of transportation, led to the already mentioned internalizing effect of the human activity in the house and the workplace, once again reducing physical activity. This is in fact the origin of numerous health problems which could be deemed as epidemic, the main cause of obesity affecting individuals and society alike with repercussions in the social and the economic sphere. The economic consequences of obesity and sedentary lifestyle for employers, business and government are staggering both in health care costs incurred and in lost productivity, and are estimated to rival those of tobacco (Kumanyika and Ross 318). On these socioeconomic repercussions, research found that more than 10% of the sick leave and higher levels of productivity loss at work can be attributed to obesity and unhealthy lifestyle behaviors (Robroek et al. 135). With obesity comes an increased rate of work limitation, along with significantly increased rates of hypertension, type 2 diabetes, the metabolic syndrome, and arthritis (Hertz & McDonald 1). Furthermore on the concern of the socioeconomic repercussions of the passive environment health problems, Robroek adds: Productivity loss at work due to impaired health has an impact on future sick leave and on individuals future health. Primary interventions on lifestyle may have a noticeable contribution to maintain a productive society (Robroek et al. 138).

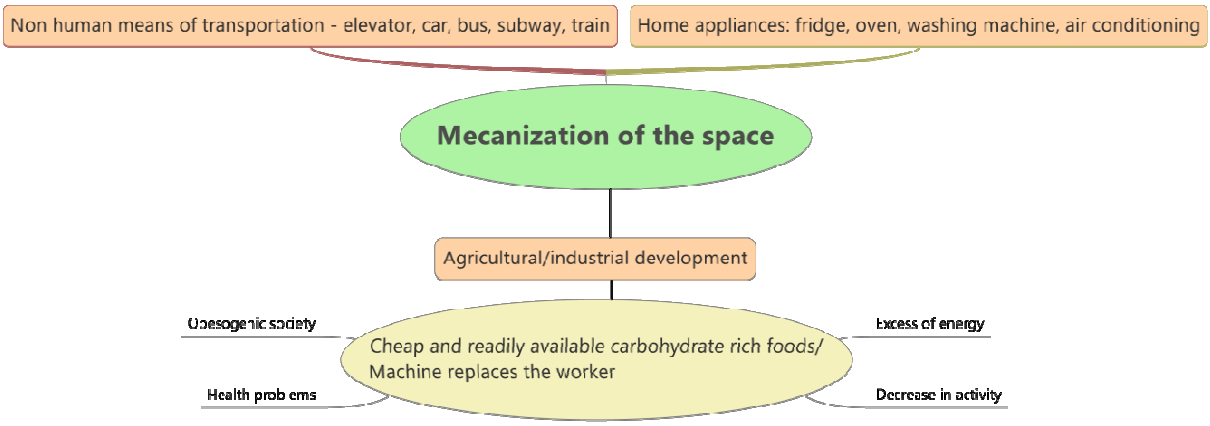
Considering the previously stated interior modifications and the functions that were gradually internalized indoors, the social space, the work space and the leisure space, the building space may now reconsider its spatial standards into a more dynamic and interactive design. Also, if the house and the workplace are the spaces where humans spend most of their time, it could acquire active features that stimulate physical activity and discourage passivity, as most adults spend the vast majority of their day in buildings and on the sites immediately around buildings. This would appear to open up new opportunities for promoting physical activity (Zimring, et al. 2005 186).

If modern humans spend most of their time indoors, should architecture consider a different approach to space? Should the house acquire a different architectural perspective focusing on the ability of movement instead of prioritizing function and comfort? Should houses and workplaces be equipped with gyms or technological appliances that encourage activity and improve productivity? It is clear by what was already stated in this study that the human body needs activity to stay healthy. The body is an architecture designed for an active environment and it rejects and reacts to passivity through health problems. Therefore, the modern human body that lives inside walls and buildings, or lives in a closed space for the most, is in fact a conditioned human body in an unnatural environment, however, there are design strategies that can improve this situation.

Architecture should realize how the human body functions and how it reacts to space in order to prevent passive environments from developing. Understanding physical environmental stimuli in facilities will allow us to create environments that positively affect the health and well-being of occupants, as evidence was found that studies manipulating several environmental stimuli simultaneously support the general notion that the physical healthcare environment affects patient well-being (Dijkstra, Pieterse and Pruyn 167). There is evidence that interventions at the building scale such as motivational point of decision prompts, aesthetically pleasing staircases, and accessible physical activity facilities can result in increases in physical activity (Kahn, 2002; Zimring et al. 2005 167). Also, improvements in the building systems and spatial configuration can eventually encourage activity and reduce inactivity related health problems, however these notions are not yet well-known as it is alluded by the following statements: To counteract the increasingly sedentary nature of work and its unintended consequences on health and productivity, corporations should consider how to integrate physical activity promotion into their overall planning process (Kottke and Pronk 8-10). However, we are only just beginning to wake up to the immensity of the obesity challenge in interior spaces (Finch 7). Therefore, designers are poised to take on one of the largest leadership roles in history, as it works to ensure all of the research results regarding the built environment and physical activity are put into action with solutions (Stone 29).



(Fig. 27) Optimization of the space synthesis.



(Fig. 28) Mechanization of the space synthesis.

(Fig. 29) (Fig. 30) (Fig. 31) (Fig. 32) (Fig. 33) (Fig. 34) (Fig. 35) (Fig. 36) The mechanization of the space. Human food supplies mechanized and readily available.

4. Walkability of Space

Buildings should be composed of spaces that coerce users to move in order to improve their walking experience and health. This chapter will discuss the walkability in the space and how it affects user's activity, followed by examples of building elements such as the circulation systems of Bernard Tschumi designs and the walking experience of the Rolex Learning Center of SANAA.

Buildings and sites are deliberately designed to support a set of activities and to create or reinforce a set of cultural assumptions. So, at the outset of any design, it can be said that behavior causes environment. However, as individuals and groups use buildings on a daily basis, they are affected by the built-in physical aspects of the building and site, such as the availability of space for different functions, relationships among spaces, aesthetics, and symbolism (Zimring et al. 2005 187). Environmental cognition research has suggested that the configuration of the physical environment can influence occupant behaviors, such as how occupants develop strategies to understand the layout of their environment and move through it (Zimring et al. 2005 190). Having said this, architecture conditions and influences the behavior of the occupants and their motivation to be active. One of the fundamental conditions in designing active spaces is the improvement of the circulation system and the increase of the walkability factor of the space. The space should be equipped with elements that encourage walking and movement and discourage the use of non human-powered means, therefore, as socially responsible designers, we need to be thinking of experiential ways to get the population moving (Stone, 30). The space should offer different options for circulation and movement, and these should be accessible and provide the user a dynamic experience in order to encourage the user to move so that he further assimilates these spatial elements and activities as part of his daily routine.

Improving the quality of movement in the space means improving the users health. Even a small increase in walking would help to substantially improve the health and quality of life of most people (Handy, et al. 72).

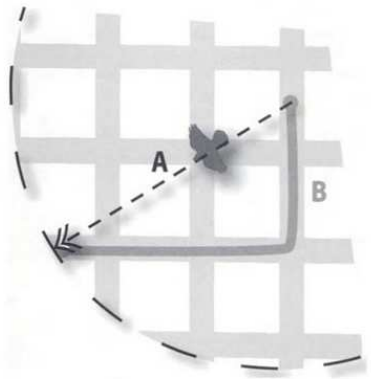
Why not consider a design that escapes certain dogmas of functionalism and instead adopt a function that increases walking and movement? Research found that residents of walkable neighborhoods who have good access to recreation facilities are more likely to be physically active and less likely to be overweight or obese (Sallis and Glanz 123–154). This concept also applies to the interior space, if it is equipped with spaces destined to physical activity, these should be accessible and inviting. However, it is important to note that the main scope of active design is to promote physical activity through the integration of movement in work or leisure activities, the utilitarian active design - which consists of those physical activities that are undertaken in order to accomplish another purpose, such as walking or bicycling to work (Frank, et al, 56).

More attention should be given to the interior empty spaces destined for the purpose of circulation and movement. Leisure activities and work activities should be organized and integrated with the physically active agenda as it is supported by Stone: designers can have a direct and positive impact

on public health and well-being by creating collaborative work environments that encourage constant movement. Designers can provide incentives for end-users to get up and move, one method that encourages physical activity in positive ways is to plan spaces to incorporate activity into daily utility (Stone, 2008). From creating collaborative work environments that encourage constant movement to allowing for plentiful daylight access, interior designers can have a direct positive impact on public health and well-being.

By slightly increasing the distance between certain elements of the space that are related to specific tasks, the space demands more caloric expenditure from the user and therefore he becomes more active and dynamic. This approach could be emphasized when dealing with sedentary activities, those could be more distanced from the core of the building. On this concern, research found that locating parking away from the building may also increase physical activity. Employees are willing to walk longer distances from parking than business visitors or shoppers, and will walk longer distances if the price of parking is less at distant lots (Seneviratne, 365–76; Zimring, 188). Also, activity-inducing spaces can increase physical activity derived from travel for regular necessary activities to destinations such as laundry rooms in residential buildings or cafeterias in workplaces (Zimring, et al. 2005 190). IBM in their data processing centers consciously put coffee stations way at the other end of the building so you have to get up from your computer and walk over there. It was more a question of stimulating interaction between the designers, a kind of intellectual thing, but it had physical mobility benefits as well (Manville and Bell 22). Working the space with a system of rewards and penalties may shape the activity and behavior of individuals - as individuals will often choose their routes based on interest rather than distance. Moreover, it is a well-known phenomenon that a subject's level of interest and the number of new sensations may make a walk seem longer or shorter than it really is (Lynch 1960; Zimring 2007 34).

This also supports the notion that health is not always related to comfort. If we design the space according solely to the function of comfort, the bodies adapt to comfort. Therefore the optimization of space in order to serve comfort and functionality, is not always positive. Through locating certain spaces in a walking distance but not immediately close, against the logical and rational thinking of function, that alone can increase physical activity and health.

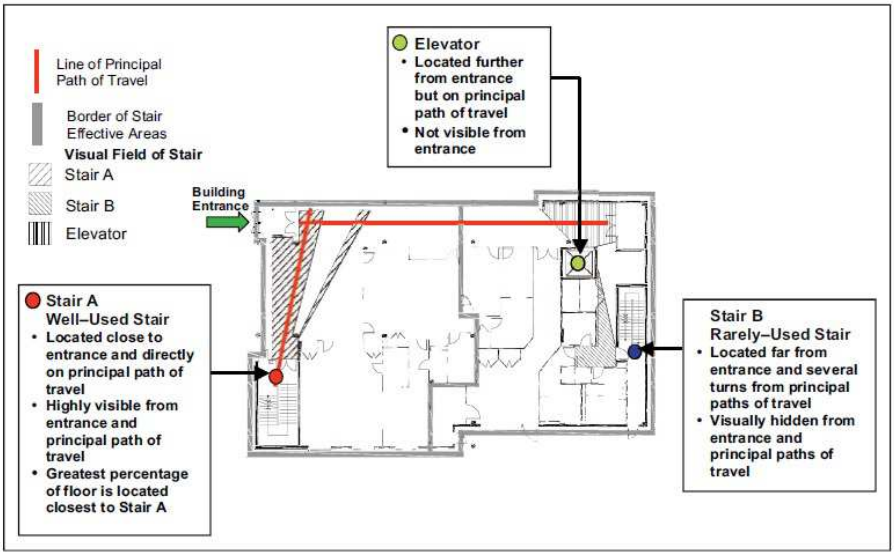


(Fig. 37) Crow fly vs Network distances. The diagonal A is the fastest route. However if a design approach can captivate the user to travel through B, this will increase physical activity.

Research found that college campus have been implementing designs that include intentionally significant distances between the parking areas and offices, longer treks between buildings, and greater distances to centralized conference and cafeteria facilities, as well as recreational walking trails (Wells, et al., 18).

By prioritizing an active element of the space which is visually accessible for the users, physical activity will be increased. By captivating the users visually into this space, physical movement will increase, as research found that specific characteristics of stimuli may be important in motivating movement. Strength of the stimulus, its size, location, prominence, contrast against background, use, and symbolic significance are among these characteristics. Also, trips through pleasant and interesting places seem shorter than trips in dull areas (Rapoport 1977; Zimring, et al. 2005 188).

Buildings and sites provide significant opportunities for increasing physical activity, but they also represent difficult theoretical and methodological challenges, yet, pedestrian movement and activities within buildings can be affected by alterations that may require only a few months to achieve (Zimring, et al., 2005 187). Most of these alterations must take place throughout the building's circulation system which is comprised of the interior spaces, corridors, elevators, stairs, and lobbies that connect the programmed spaces of the building, therefore the circulation system is the main building element that provides opportunities for walking (Zimring, et al., 2005 190).



People are more likely to use stairs that are visible and convenient along their principal paths of travel. Source: Nicoll 2006

(Fig. 38) Active design prioritizes the access to the stairs.

4.1 Motivational concerns of active design.

Designing an active space is a question of coercing the users to be active by stimulating their body senses and encouraging their choice to move. Several references state that the architect can suggest the user to move by several methods, since every architecture is stimulus for potential movement, a building can always be a stimulator of action, a space where movement and interaction takes place (Bloomer and Moore 72). In essence it is up to the user to decide, but the space and the environment have significant influence on the user motivation. The motivation of the user depends on the interactivity of the space, on its design features that stimulate activity.

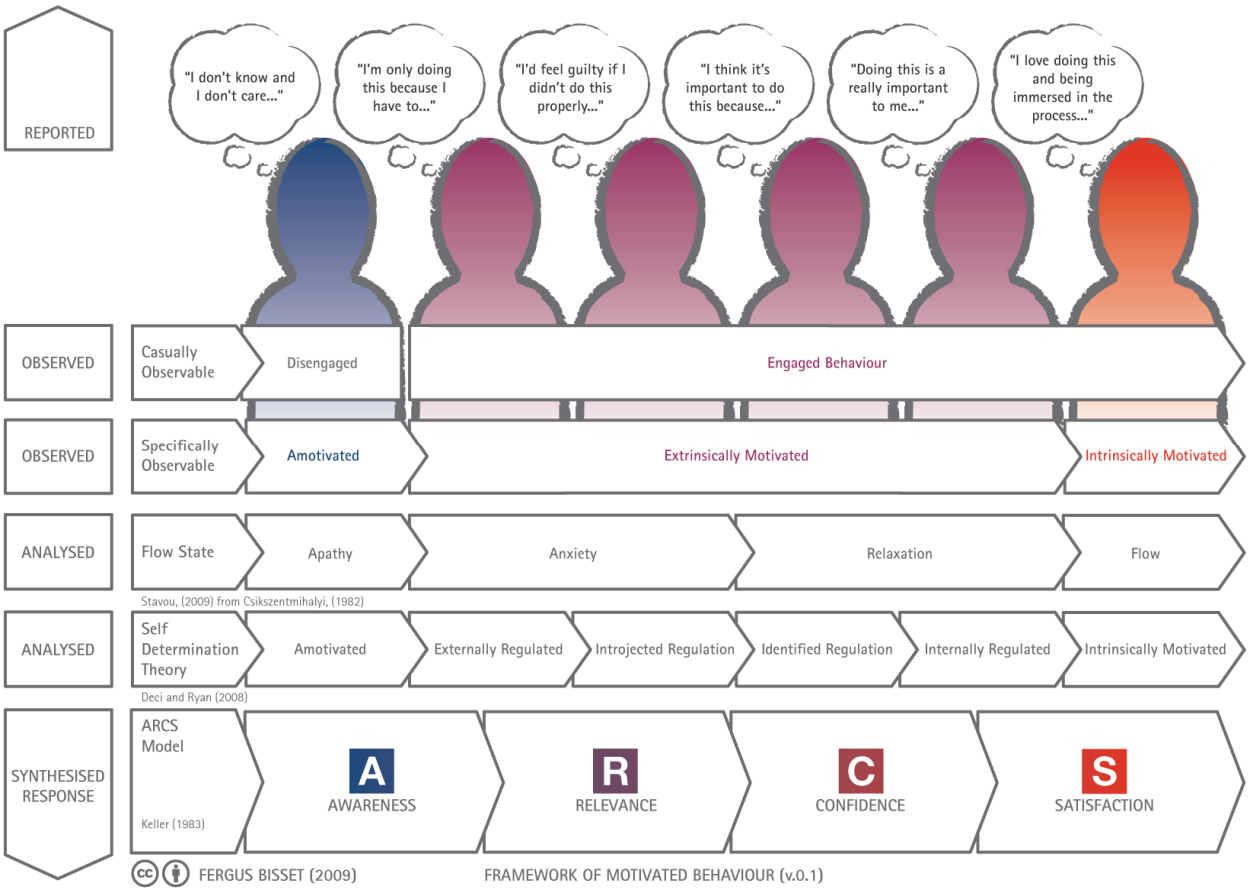
People are more likely to make healthy behavior choices when these choices are easily available to them, and thus environments that support or discourage healthy behaviors critically influence health (Gebel et al. 5). Also, where individuals live, learn, work and play all have a major impact on the choices they are able to make - People are more likely to make healthy behaviour choices when these choices are easily available to them; and thus environments that support healthy behavior (Levi 3). Therefore, an embedded health environment is a space that coerces occupants into physical activity, as part of their everyday work routine (Finch 7). This notion is also expressed by Glanz and Sallis: Embedded physically active environments are those designed to support daily activities (Glanz and Sallis, 2009). Therefore, motivating activity is a question of combining daily tasks with an increased value of physical activity, this complemented with the strategy of increasing the proximity and convenience of physically active spaces and decreasing the access to sedentary spaces (Epstein, 1998 262), will allow users to choose exercise over a concurrent and powerfully competing sedentary behavior (Epstein and Roemmich, 2001; Hebestreit and Oded 136).

It is a question of improving the motivation and encouraging the user to choose active interaction with the space rather than a passive interaction with the space. If the environment promotes healthy activity, and discourages unhealthy activity or if the space has criteria that allows and encourages physical activity and exercise. The reason why an individual is willing to be physically active is a question of activity and utility, what makes the body choose movement instead of inertia. It is important to note that inaction is always necessary, in the form of interval spaces, as resting, or alternation is part of the action.

However, it is important to note that a major assumption on this analysis is that in most cases, human psychology will choose to be sedentary if everything in the environment incites in that direction. Alluding to this Epstein and Roemmich stated that: In many situations, both the access to and the reinforcing value of the activities differ, and both factors are considered when making the decision to exercise or remain sedentary. A more direct approach is to make physical activity more reinforcing, so that regardless of the sedentary options, people will opt for more physical activity (Epstein and Roemmich 103-08). Other examples of physical modifications that affect the psychology of users include improving workplace safety, modifying work stations and office layouts to decrease sedentary

behavior, and encouraging physical activity (Carnethon 2009 1728). Therefore the structural aspects of the built environment are not the only influence on the human active behavior, as the psychological status and measures of the social environment are also important influences on activity (Papas et al., 129-43; McNeil, Kreuter, and Subramanian *11-22).*

As conclusion, the most effective interventions should operate at multiple levels to create an environment that makes it easy to make the healthy choice, enhance social norms and social support, educate and motivate individuals to take advantage of the opportunities for healthy behaviors, and use policy to provide activity programs (Sallis and Glanz 4). If the users are motivated they will often visit physically active spaces within the interior space, improving the sense of energy of the space. In order to motivate the user to walk, the designer needs to pursue an approach that reduces passive behavior and stimulates active behavior. If it depends on users personal status, it is very relative if the space will be active or inactive, however, it is the scope of the designer to induce action.



(Fig. 39) Fergus Bisset Motivational Design.

4.2 Tschumi Active Approaches

Bernard Tschumi spatial configurations improve the walking experience of users and maximize activity through the implementation of circulation system strategies as the defining elements of the project. Following the precedent argument on the situationists international, Tschumi seems to answer some of the movement theories in his architectural space by invoking a sense of anti-architecture[3] (Tschumi, 1996 250), freedom of movement and unexpected experience - a space that has no inventor, no author and no architect, that cannot be described but is the disoriented space of someone who has lost his way (Hollier 57-58; Ebert 18). This enhances a sense of sponteinity in the building space which is defined by smooth transitions and multiple connections between spaces that seem to originate from the user initiative to move - when the flow through different spaces is smooth, the transition is gradual and the thresholds are marked, a building slowly unfolds, revealing more about itself as it is used (Jacobson, Silverstein, and Winslow 157). Tschumi architecture introduces the user to different itineraries and paths which gradually reveal different events through the space and captivates the user's movement. As research found that when investigating the relations that mediate between an event and the time in which the latter manifests itself, we have come to define the concept of movement as a key factor in the generation of new spatiality. Therefore, the space is the fruit of a symbiotic process between two terms; that is, events and time (Guallart and Cantarella 114). Also, Tschumi spatial approaches prioritize action over the static form through the application of events, activities, use, incidents which are always superimposed on those fixed spatial sequences (Tschumi 1996 157).

Bernard Tschumi seems to pursue a natural and anarchic approach in the relation of the body with the built environment - Tschumi's design was a partial response to the philosophies of Jacques Derrida, acting as an architectural experiment in space, form, and how those relate a person's ability to recognize and interact (Derrida 21-22) and may wish to be subjected to such spatial aggression, just as you may go to a rock concert and stand close enough to the loudspeakers to sustain a painful – but pleasurable – physical or psychic trauma (Tschumi, 1996, 124-25).

However this freedom of movement and susceptibility is not arbitrary as Tschumi imposes limits and constraints that configure the space and direct users into certain events - Tschumi insists on the idea of limit, of interruption (Tschumi, 1996, 210). These events are intervals that generate activity and motivation through the use of repetition and frame sequence, as parameters that remain constant and passive for the duration of the sequence can be added and transferred, and when a given spatial configuration repeatedly passes from frame to frame, from room to room: it constitutes a displacement (Tschumi, 1996, 168). Also, we should have in consideration that adding events to the autonomous spatial sequence is a form of motivation (Tschumi, 1996, 157). Therefore, it seems that Tschumi spatial configurations alludes to an attempt to let the user play within the space, through sequences

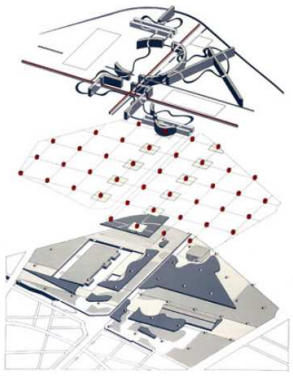
[3] Anti-form, anti-hierarchy, anti-structure.

and variations. This movement of play is sustainable in nature, as it is in a constant state of renewal through repetition and alternation (Huizinga 10).

Tschumi active approaches can be seen on the designs of Parc de la Villette, the Marne School of Architecture, the Le Fresnoy Art Center, the Learner Hall Student Center and especially in the unbuilt but rather unique design proposal for the National Library of France. Additionally and to a lesser extent the Bridge of La Roche-Sur-Yon and the Alésia Museum and Archeological Park.

The Parc de la Villette is a complex synthesis of diagrams and juxtaposition of plans that generate actions and paths. These paths and events promote activity and the immediate experience of the user. It merges the concept of the landscape in harmony with the built environment - it opposes the landscape notion of Olmstead, widespread during the 19th century, that “in the park, the city is not supposed to exist.” Instead, it proposes a social and cultural park with activities that include workshops, gymnasium and bath facilities, playgrounds, exhibitions, concerts, science experiments, games and competitions, in addition to the Museum of Science and Technology and the City of Music on the site (Tschumi 2013). Play, exercise, markets, and other activities are welcomed by the surfaces of the park. Surfaces that are unprogrammed are demarcated through their materiality of compacted earth and gravel, a park material familiar to all Parisians; differentiation in materiality denotes complete programmatic freedom to users and activators of the park (Tschumi 2013).

These programmatic freedom is further emphasized as the park creates a series of empty spaces for the purpose of spontaneous event creation that stimulate activity, this concept of empty spaces will be discussed ahead. By allowing visitors to experience the architecture of the park within this constructed vacuum, the time, recognitions, and activities that take place in that space begin to acquire a more vivid and authentic nature (Tschumi 1996 108-119). The park strives to strip down the signage and conventional representations that have infiltrated architectural design and allow for the existence of a “non-place.” This non-place, envisioned by Tschumi, is the most appropriate example of space and provides a truly honest relationship between the subject and the object (Papadaki 20-24). This non-place is an event space - which is directly related to the senses of the body - “understandable” only to the *shintai* (Japanese for sacred body) (Dods and Tavernor 306).



(Fig. 40) Parc de La Villette diagrams.

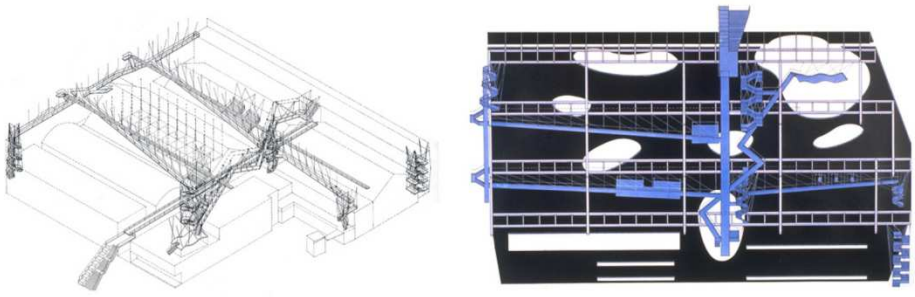
(Fig. 41) Marne School of Architecture.

The design of Marne school of architecture distinguishes itself with its central body that serves as a bridge for the continuous walking paths that cross the central atrium and connect the different spaces of the building. The whole building is equipped with a overflowing use of stairs and walking bridges which improves its dynamism and coerces the users to move through the space.

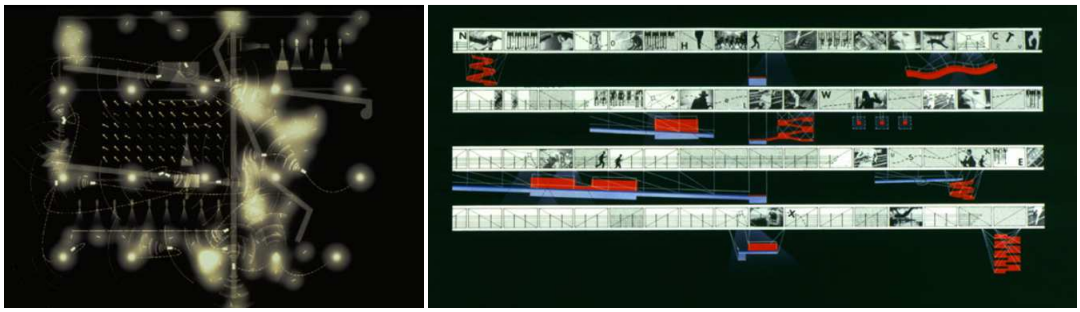
The circulation is also gathered together in this central body in the form of staircases and steel walkways that crisscross the space, forming a multi-leveled suite of open passageways. This transforms the building into a large promenade, which, as in a city, can have several points of departure as well as multiple shortcuts through it. The 400-seat amphitheater - a striking “object” posed within the space and covered in shimmering extruded metal - can be accessed by stairs and by walkways (Tschumi 2013).

The Fresnoy Art Center follows the same tactics of the previously discussed designs - containing places for installations and film projections located along a dramatic sequence of walkways (Tschumi 2013). These film projections are positive technological element as it rewards the user through the walking experience of the building. The building configuration is equipped with complex vertical and horizontal circulation systems in combination with the described event spaces.

(Fig. 42) (Fig. 43) (Fig. 44) (Fig. 45) Fresnoy Art Center interior space and circulation system.

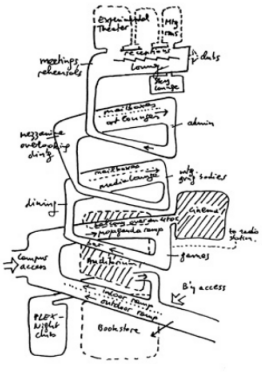


(Fig. 46) (Fig. 47) Fresnoy Center circulation system.

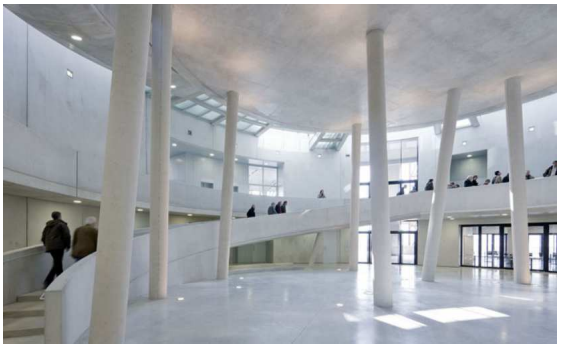
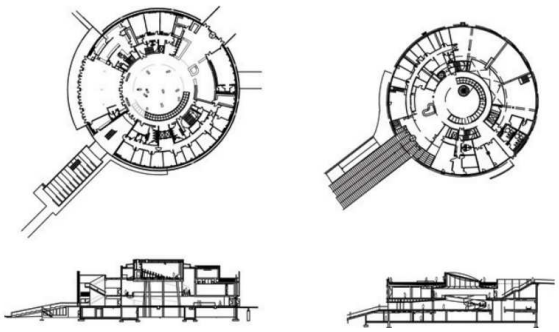


(Fig. 48) (Fig. 49) Fresnoy Center event spaces.

Although to a lesser extent, the Learner Hall Student Center is another example of a strategic use of paths and user movement to generate spaces through - the dramatic void-space that is animated and defined by the movement of students and visitors along the ramps (Tschumi 2013). The Alésia Museum and Archaeological Park presents the user a dynamic circular space incorporated into an helicoidal ramp.


(Fig. 50) (Fig. 51) (Fig. 52) Learner Hall Student Center circulation system.

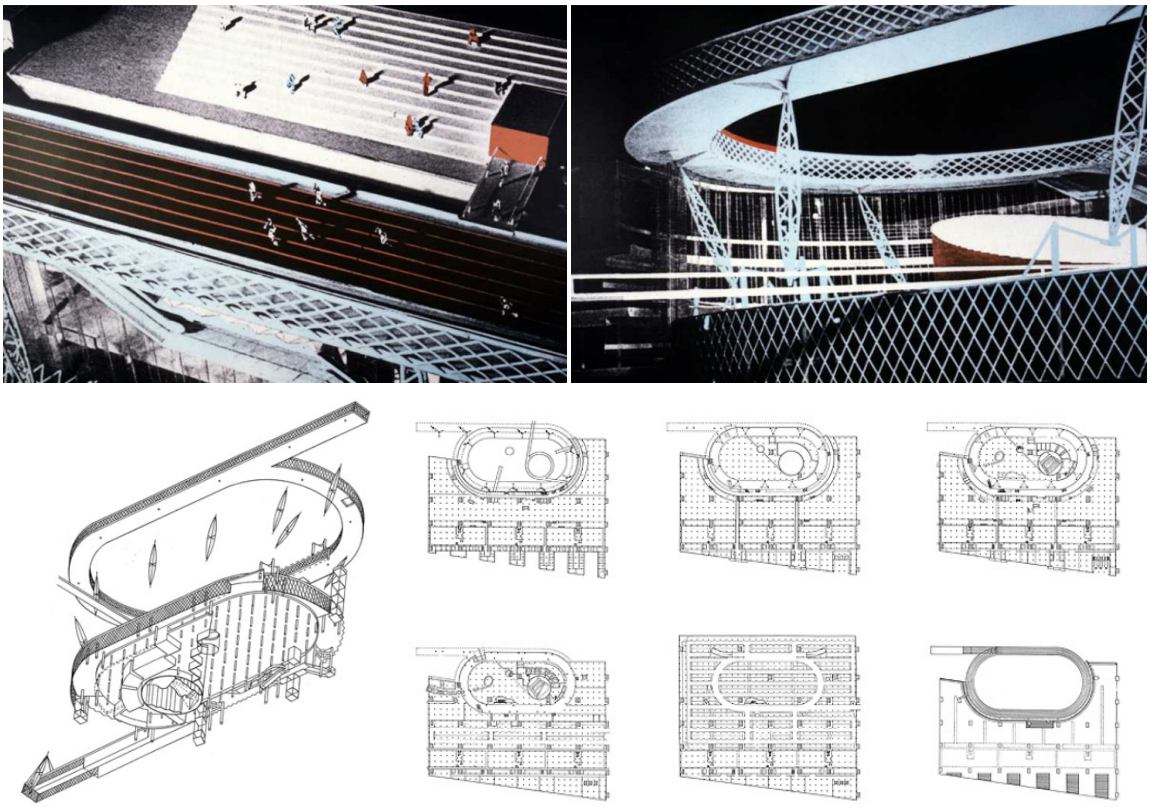



(Fig. 53) (Fig. 54) Alésia Museum and Archaeological Park.

The bridge at Roche-Sur-Yon is a good case of an architectural intervention that breaks through an imposed barrier in the urban environment that blocks the connection between two areas. This bridge links the historic city founded by Napoleon (“the Pentagon”) with new neighborhoods, this pedestrian bridge crosses above high-speed railway tracks, providing an important urban connection for the town (Tschumi 2013). This concern reflects the importance of overcoming barriers in active design.

(Fig. 55) Bridge La Roche-sur-Yon.

The design proposal for the National Library of France is the maximum expression of active design. Tschumi links both the metaphysically active space with the physically active space, by connecting the space of the athlete, the oblong running track, with that of the intellectual, the library in one single building - a new type of library, one that combined the pursuit of modernity with the pursuit of knowledge and the athlete with the scholar (Tschumi 2013). The following words clearly express this concept: The program was about circuits and movement - and so the entire architectural scheme was developed around a constant dynamic. Inside, there were multi-media circuits for the public and circuits for the storage and retrieval of books. On the upper level was an exhibition circuit and, outside, a running track, designed with the assumption that the athlete of the 21st century would be an intellectual and that the intellectual of the 21st century would be an athlete. (...) Within the new library, five interrelated sets of circuits can be identified: visitors and administrators circuits, book circuits, electronic circuits, and mechanical circuits. While each has its own logic and set of rules, the circuits constantly interact at strategic locations. Locating a running track over the library embodied the building's complex role in developing an urban strategy that was expressed in the open circuit. The library was seen as an "event" rather than as a frozen monument (Tschumi 2013).



(Fig. 56) (Fig. 57) (Fig. 58) Design proposal for the National Library of France.

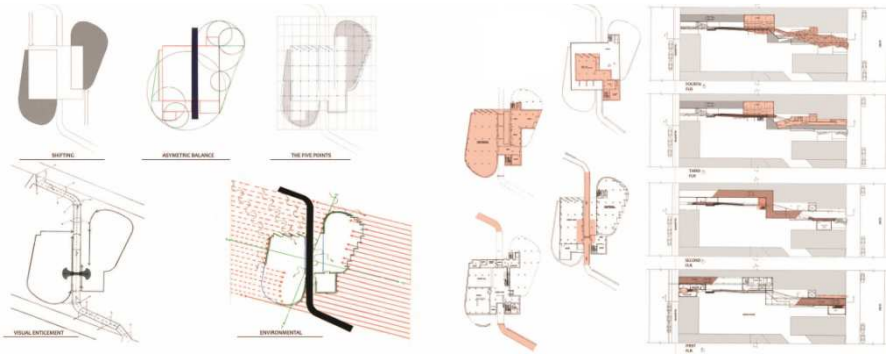
4.3 Other Examples of Walking Spaces

The previous designs of Tschumi are always related to the walking experience. By improving the experience of the user into a more captivating walking experience, it automatically improves the daily average activity of the users, therefore improving their health. On this concern research has found that increasing walking to about 2 kilometers per day is roughly equivalent to the public health goal of at least 30 minutes of moderate activity per day (Frank, et al. 2004 10), therefore, increasing the walkability of a space is contributing to users general health (Carnethon, et al. 1-13). On this concern research also found that: buildings should have an indoor walking path a mile distance marked off; lighted, attractive stairwells; and free or markedly reduced access to exercise clubs (Carnethon, et al. 1728). An important fact to note is that caloric consumption is not only generated by vigorous physical activity but also by small movements while standing up. An improvement would be to encourage the standing position for certain amount of time per day, that would break the habit of sitting and would make the walking experience more approachable.

Increasing the number and complexity of paths are always a positive asset to active design because it generates action and new possibilities, as research suggests that if path choice is limited (i.e., if there is only one path), interactivity is weakened (Zacharias 405-12). Peponis and Wineman also allude to this notion: It is important to note that the correlation between integration and user activity seems consistent in a system of multiple choices (Peponis and Wineman 271–91). Therefore, to improve walking experience standards, building spatial configuration should pursue a methodology that prioritizes the movement of the human body - the space must be conceived from the perspective of the moving body such that as “bodies transgress in time they are connected to other bodies, other rhythms, and other actions” (Jormakka 80). Also alluding to this Guallart and Cantarella states: the most natural way of inhabiting an intelligent space would be for it to understand our actions and desires simply by the movements of our bodies (Guallart and Cantarella 88).

Following this notion of the active walkable space, buildings should take maximum advantage of the landscape and site properties in order to enhance the walkability of the circulation system. Le Corbusier was a master in relating different forms of moving (Bloomer and Moore 80). Apart from the *Villa Savoye* ramps which were already mentioned in this study, the Carpenter Center is a good example of such approach. The building takes advantage of the land slope so that the upper floors can be easily accessed through ramps without the need of the elevator - diagonally crossing through the building’s midpoint on the second level is a pedestrian ramp, from which various academic programmatic functions are variously distributed (Frampton 2001 217). It also engages the user experience by - twisting and turning of the trajectory as “an exacerbation of the theme of the architectural promenade" (Chaslin and Höfer 7).

Another building that follows a smart interpretation of the circulation system is Frank Lloyd Wright's Guggenheim Museum in New York. The museum's circulation system is again an helicoidal ramp that guides the users through the exposition until the last floor, promoting walking over the use of the elevator, and rewarding the user visually and tactilely as he walks upwards.
Through the implementation of such strategies the building improves user activity without direct effort.

(Fig. 59) (Fig. 60) Carpenter Center ramps and circulation diagrams.


(Fig. 61) (Fig. 62) Guggenheim Museum circulation system.

Design approaches must be conscious of their influence on the environment and the space, and should develop strategies that increase the necessity of walking in the built environment. This will gradually increase the physical activity of occupants and whence improve their health. Also, architects need to carefully reexamine their assumptions in relation to space utilization and travel time. Is travel distance something that should always be minimized (Finch 7)? Active walking spaces and active environmental changes may take years to show results, however, the beneficial effects can be expected to contribute to long lasting improvements in physical activity, eating, and obesity (Sallis and Glanz 123–154).

4.4 Rolex Learning Center Approach

The built environment should be less packed, more wide and with strategic empty spaces. The design of the space should emphasize the dynamism of circulation, unobstruct the walking experience and offer movement options which discourage permanent passive behavior. Buildings should incorporate features that not only allow movement and physical activity but make the whole concept of movement an engaging experience of the space. The Rolex Learning Center of SANAA is good example of a building which embodies this concept of making a space more dynamic by improving the physical experience of the users.

As it was already discussed in this study, buildings can at times alienate our senses and activity, however they can also enhance an active experience. If we consider the origin of cities, the natural corrugation of landscape faded away and gave path to a rather standardized landscape of restricted movement, or at least an adapted movement to modern means of transportation. This stretched-out geography of the modern city, in concert with modern technologies desensitize the human body (Sennett 21).

SANAA's Rolex learning center is an example of an architecture that internalizes this external slope of the natural landscape, reinforcing the interaction of the body with the space. It is virtually a clean space, however, its dynamic nature lies on the interaction of the space with the user. The user has to climb the steeped surface and has to adapt his body motion to the space.

To support this notion research has found the following statements of Francesco Casa: The building is an interior landscape (Casa 163), its spaces are enclosed in a network of curbed glass walls in such a way that the perception of the interior space is always in relationship with the exterior environment (Casa 105). The roof follows floor's topography (Casa 152). Also, the difference of height in the Rolex Learning Center offers the possibility to avoid walls (Presses Polytechniques 2:30 min), enabling the possibility to replace barriers by an undulation of the floor. This undulation of the plane creates depressions and raised surfaces in different sizes and on different scales - some are open and others closed, creating identifiable spaces and zones without cloistering them with opaque limits - the eye passes over these spaces defined by ascending and descending slopes. The view practically spans from one end of the building to another. The space is thus enclosed and continuous - in simultaneous relation with what is close and what is distant (Casa 166). Therefore we are presented with a space that stimulates the users visually and tactilely.

Another interesting aspect of this architecture is the concept of the contemporary micro-city building as it is alluded in the following statement: The building was designed as a micro-city incorporating several functions in its interior landscape. The Rolex learning center functions as a mini city with a program that includes: an electronic library, a network of stimulating meeting places, a bookstore, a traditional library, a career center, a laboratory for learning technologies (CRAFT), a student association, a

futuristic bank, and even a publishing house - a multifunctional center looking to open a dialogue among all its capacities (Casa 74). Though, the micro-city concept was approached through an active perspective that offers all these spaces inside the building, the design also internalized a landscape that allows a dynamic travel through them.

The Rolex Learning Center engages the senses of the users in a peculiar way that captivates them to interact with the space. One remarkable aspect of this architecture is that it requires several senses to be fully perceived. Eyes closed, we sense the ascent and descent of the slopes - it has valleys yet no stories. The audible experience is equally stunning for the vas building does not allow the slightest echo. The sounds are kept within the bounds of hills and valleys, as if in a room with invisible walls. (...) It succeeds in creating a simultaneous sense of closeness and distance (...) It is an amplified space; for it is a space that both affects several senses at once and involves the sensation of simultaneity (Casa 171). It is definitely a building designed for the movement of the human body in which the external natural landscape is simulated in the interior which stimulates user movement in an utilitarian way with its communicative and emblematic value as the result of a profoundly new approach to space and function; the relationship between interior and exterior, of Man[4] in movement (Casa 219).


(Fig. 63) (Fig. 64) Rolex Learning Center sloped space.


(Fig. 65) (Fig. 66) Rolex Learning Center skying experience.

[4] Human.

5. Built Environment Elements and Active Design

The human senses dictate how the active space is perceived as active. By the implementing certain building elements that appeal to these senses, designers can improve the activity of the space. Certain individual examples can provide a clue of how the senses can be stimulated by building elements and design in order to encourage activity. On this concern, research has found three different statements from different authors: Active design is environmental design that encourages movement and physical activity, through walking, stair climbing, bicycling, transit use and active recreation (Burney et al., 6). Also, to experience architecture in a concrete way means to touch, see, hear and smell it (Zumthor 58). And there are five fundamental sensations derived from the tactile sense: pressure, heat, cold, pain, and kinesthesia (sensibility of movement) (Bloomer and Moore 45). This chapter will analyze these building components and particular architectural examples.

A building is not an end to itself; it frames, articulates, restructures, gives significance, relates separates and unites, facilitates and prohibits (Pallasmaa 2006 35). The key elements that in general define and condition active design are stairs and ramps, vertical circulation; corridors and empty spaces, horizontal circulation; distances and geometry of the space; lighting and color of the space; barriers and obstacles and spaces for physical exercise.

The building's circulation system comprises the interior spaces, corridors, elevators, stairs, and lobbies that connect the programmed spaces of the building. The following statements support this notion and give a clues on active design: The circulation system provides opportunities for walking, the most popular type of physical activity. While little research has measured actual walking behavior, environmental cognition research has suggested that the configuration of the physical environment can influence occupant behavior, such as how occupants develop strategies to understand the layout of their environment and move through it (Hillier 1996; Zimring et al., 2005 190) Features such as elevators, and barriers such as door locks, grade changes, non-ergonomic design, and poor placement of building elements can not only deter physical activity, but potentially can neutralize other features designed to promote physical activity (Leibrock 2000; Zimring et al., 2005 190.) Also, the presence of the elevator denies the need for contiguous functional relationships (Eisenman 2008).

The effect of building programming and design on physical activity may be conceptualized in terms of three basic features within the building: (1) the provision and design of activity-programmed spaces, (2) the provision and desirability of activity-inducing spaces and amenities, and (3) the design of the building's circulation system. Activity-programmed spaces include specialized spaces like exercise rooms, swimming pools, running tracks, and multipurpose rooms that could be designed as venues for physical activity. Views of people, activity, and nature from exercise areas as well as views into these spaces from the paths of travel along the building's circulation system potentially increase use of these spaces (Regnier 1994; Howell 1980).

On the circulation systems they depend on the availability of dynamic walkways and the control of environmental barriers and obstacles for the scope of improving user's activity. This notion of the barriers and obstacles is suggested in the following statements: The emotional experience of architecture is above all an experience of limitations, a blockade or widening of our views, a tendency for the infinite with our bodies settled in the physical space (Domenico, 79). Environmental barriers, in turn, are the real-world conditions that restrict exercise (Frank and Engelke 2001 208). Architects need to focus on the environmental barriers since they are factors that exist within the built environment (Frank, Engelke and Schmid 2003 59). Therefore the control of barriers and obstacles is primordial in the design of an active space.

Other simple elements and factors can influence user activity in the space, as Ferrara and Murphy stated: Three well-controlled studies have used both motivational signs and aesthetic interventions such as music and artwork, and have found that more people used the stairs (Ferrara and Murphy 1). These assumptions serve to assert that audiovisual elements influence body movement, therefore influencing active design.

On the visual perception of the space the perspective is a three dimensional representation of infinite movement. The perspective was largely studied in the renaissance period when architects developed a deep interest in the body architecture, when - buildings and cities were thought in relation to the human body (e.g. Sennett 24, 102). The perspective is the concentration of the visual sense into one absorbing point. Several architectural spaces prove that the perspective can be inductive of movement by captivating the users attention and interest to this point. The modern use of the perspective in the Louis Kahn's Salk Institute is an example of how the perspective can be captivating and therefore spark interest and motivate activity. The empty space removed of barriers, the sense of monumentality with the sequential flanking bodies that drive the eye to the infinite, and captivates the user's interest - a street flanked by a sequence of buildings produces the sensation of being inside a canon (Bloomer and Moore 74). These concrete bodies which are very tactile, the line that converges to the infinite in the form of the narrow and linear water pool - the square free of trees (obstacles) and the facade to the sky (Frampton 1995)[5], are subtle spatial elements that were intentionally formulated to push the body forward, to create suspense, to provoke interest in the upcoming hidden landscape and view of the sea, which is rewarded to the user as he walks in this direction, again quoting Domenico and Zimring: the emotional experience of architecture is above all an experience of limitations, a blockade or widening of our views, a tendency for the infinite with our bodies settled in the physical space (Domenico 79), and the aesthetic and visual experience are fundamental in guiding movement over and above configurational aspects. (Zacharias 23-25; Zimring et al., 188-189).

The path is by nature a void destined to conduct human movement (Bloomer and Moore 104). The element of the line that converges to the infinite is also used on the work of the artist Richard Long, walk spaces. A line is placed in the space which defines a path. More than a path it defines an

[5] Luis Barragán quote.

intention which is subliminally induced on the user to persuade him to experience the space in that direction, see (Fig.68). The Jewish Museum in Berlin of Daniel Libeskind presents an interesting relationship with this concept in its underground paths. These underground paths are empty spaces accompained by a line of light in the ceiling, guiding the user through an experience that symbolizes the history of the Jewish people. The intention of these spaces is to present the user a continuing walking experience with meaning. In addition, the whole building is a space directed to the tactile sense, which is of importance to this study. Although, the building is not directly related to physical activity, it is related to the features of the space which stimulate the tactile and visual human senses and therefore give meaning to an action.

Similar results of provoking a reaction of movement in the user are seen in Luis Barragán interior spaces, however this time with the use of color. In Casa Gilardi, Barragan uses color to captivate the user into the hall. The yellow color is first presented to the user with its vibrating and stressing impact which gradually increases from the dark into light, with a constant sequence of narrow windows, ending in a comforting blue room which is perceived as the reward for the end of the path.

Therefore we can assume that smart use of color and lighting can promote walking (Nair and Ditton 25-7). The following authors also support this notion: A visible walking surface is a fundamental provision for the promotion of movement (Turner and Penn 473-490). Visible connections and walking surfaces are key elements of Lynch's concept of legibility, in which the user uses visual cues to gain an understanding of the environment and organize it into coherent patterns (Lynch 1960; Zimring et al., 2005 189). Also alluding to this notion Zimring similarly states that simple audiovisual interventions my enhance active design: In a 2-year study in one of their own buildings in Atlanta, the CDC progressively improved the lighting, and added art, music, and color; they found persistent modest increases in use, all at a cost of $16,000. The results of the CDC study led them to recommend improved stairs in all of their facilities worldwide (Zimring et al., 2005 190).

(Fig. 67) Louis Kahn Salk Institute.

(Fig. 68) Richard Long walk spaces.

(Fig. 69) Luís Barragán Casa Gilardi.

(Fig. 70) Daniel Libeskind Jewish Museum.

5.1 Active Stairs

Horizontal paths play a very important role in determining the activity of the users. But buildings are also vertically oriented. That means one of the most important features of the building in active design is the vertical circulation system. Several studies have found that relatively modest increases in stair use can have positive health and lifestyle effects (Boreham, Wallace and Nevill 277-81; Zimring et al., 2005 190). The Harvard Alumni Health study of 11,000 men found that those who climbed at least 20 floors per week had a 20% lower risk of stroke or death from all causes when controlling for a large number of demographic and other risk factors (Paffenbarger et al., 605-13; Grobman and Amster 75). More research on this subject has shown that two minutes of stair-climbing a day equals 5,800 kilocalories a year (Manville and Bell 22). Moreover, the State of California and the U.S. government have built office buildings where the main elevator banks will stop only on every third floor, and where able-bodied workers and visitors will be expected to walk up or down to their floor (Zimring et al., 2005 191). To completely support this notion, Zimring states that: two minutes of additional stair climbing per day would result in weight reduction of <1.2 pounds per year, more than eliminating the 1-pound per year average weight gain by U.S. adults (Zimring et al., 2005 190). Therefore, stair use at work has the potential to increase physical activity and decrease obesity (Mansi et al., 614).

As it was mentioned before, motivational design does not completely depend on the designer but on the will and determination of the user, and although architecture as long used the design of monumental stairs and captivating circulation paths to encourage movement. In modern buildings elevators and escalators are saliently located and inviting, whereas stairways are typically unattractive, inaccessible, and frequently hidden from entrances with small signs denoting their location, mainly in connection to fire exits (Mansi et al., 610). This situation should be inverted, and instead the stairs should be placed first in the hierarchy of the space and they should be presented in an attractive manner that rivals that of the elevator. Darling and Heinen stated that stairs are spatial components that can increase physical activity, especially if they are presented as attractive central stairways (Heinen and Darling 104). On the question of being central, we assume it is relative to the spatial configuration and the design approach of the specific project.

Buildings should be designed with attractive stairwells that are accessible to the general population (Boutelle, et al., 2001), these stairwells can be a low-cost and relatively accessible way to add everyday physical activity, however, many building stairwells are inaccessible or unpleasant and elevators are far more convenient (Nicoll and Zimring 2009 1). Stairs provide an example of the complex interactions between environmental scales that characterize building design and use. Local characteristics of a building such as color or art in a staircase, or even point-of-decision prompts, can influence behavior, as can relational characteristics such as views to and from a staircase (Zimring et al., 2005 191).

The skip-stop elevators and stair design strategy referred previously were envisioned as a means of organizing the high-rise building into a more human scale, increasing personal interaction and office cohesion among employees, and increasing physical activity while decreasing nonproductive time spent waiting for elevators (Nicoll and Zimring 2009 113). Strategies such as the use of stairs for short trips, minimize need for escalators and reduce inefficient use of elevators. The easy access between floors and departments running along the glass wall of the exterior create invigorating experience – a nice break to the working routine (Manville and Bell 18). Also on this concern Heinen ad Darling state that in choosing and managing facilities, designers should consider how safe and attractive they make stairs (Heinen and Darling 117).

The Fujimoto wood house is an example of a space that improves the active experience of the users without compromising the function nor clearing environmental obstacles. By generating different spaces around this staircase building the user feels captivated to scale the building and experience the different spaces. The building is presented as a challenge or as a ludic space where the user feels compelled to play in these different levels.

Although to a lesser extent, another subtle example of stair use is Siza Vieira housing for SAAL (Servicio de Apoio Ambulatorio Local), the national housing association, consisting of 1,200 low-cost, housing units, all with courtyards (The Pritzker Prize para. 7). Although low-cost, the houses are organized around this courtyard where the child can play. The houses are accessed through a row of stairs which directly access the first floor increasing the daily physical activity of the occupants, however this can pose a problem on the mobility of elder users.

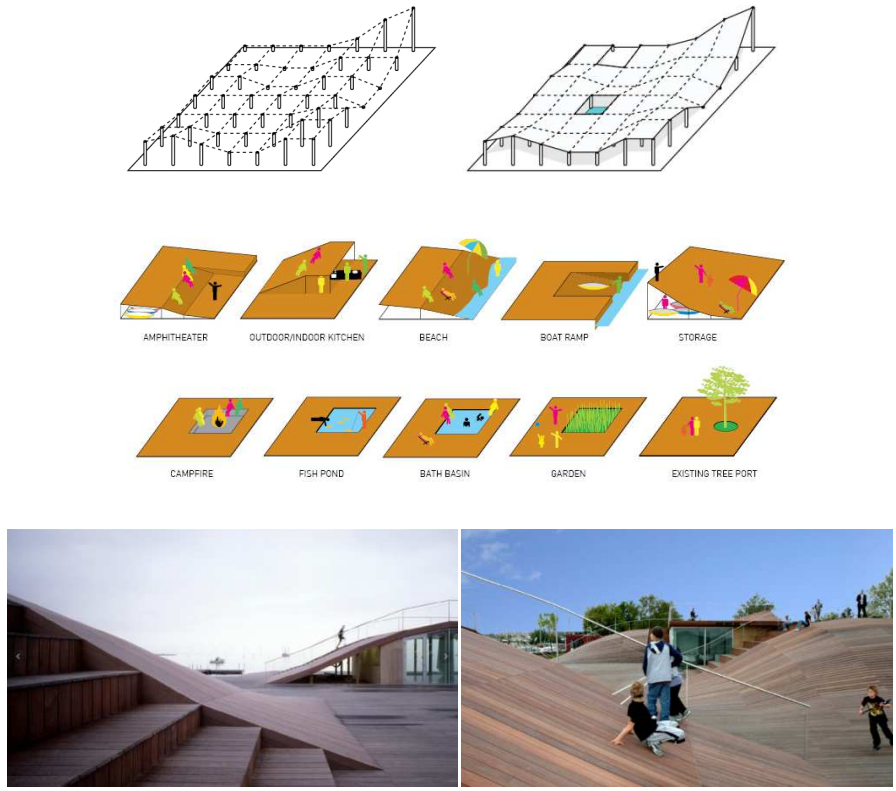
This free central space, the courtyard is deemed to be an active space for its lack of obstacles and barriers and its inherent mobility potential. Much can be said on the empty space and the elimination of obstacles as part of activity enhancing environments. The suppression of elements, details and the homogenization are in general positive efforts in the design of active spaces. However, this concept can also aggravate the monotony of the space, therefore it is at times counterproductive - as the variety of details are considered indicators of quality in the active environment (Martincigh, 2003; Zimring et al., 2005 189) and can add value to the active space. Nonetheless, the overuse of physical elements in the space and the overcrowding of space are definitely detrimental for activity - children are at particular risk of poor health as a result of limited space and overcrowding. Children who live in high rise housing tend to experience restricted access to play areas which may be linked to more behavioral problems, increased mental and physical health problems (Cave and Molyneux 24).

Evidence suggests that surrounding moving objects are deterrent to user's activity and movement such as in heavy circulated promenades (Forward 1998; Zimring et al., 2005 189). By increasing the barriers and obstructions in the user's path this can decrease the speed of movement. However the establishment of a dynamic space and itinerary, composed by the subtle position of objects, in other words, a space which is alternated and with different possibilities, and that in turn decreases the monotony of the experience, may improve user interactivity.

(Fig. 71)(Fig. 72)(Fig. 73) Fujimoto wood house.

(Fig. 74)(Fig. 75) Siza Vieira housing.

(Fig. 76) Maritime Youth House JSDA. The raised floor provides a play space.



(Fig. 77) (Fig. 78) (Fig. 79) (Fig. 80) (Fig. 81) Maritime Youth House JSDA. The raised floor provides a play space.

These notions serve to counterbalance the obesogenic environment and enhance active design. To reaffirm the notions behind this study: Obesogenic environment is composed by elements which encourage food intake and discourage physical activity. An active friendly environment is one that promotes healthy food choices and encourages physical activity (Swinburn, Egger and Raza 1999; Bray and Bouchard 180). Designers have a unique opportunity to address the obesity problem through identifying and creating aspects of the workplace, homes, schools, urban and community plans that promote a healthier lifestyle (Stone 29). The perceived or actual cost and benefit of activity-friendly features play a large role in whether they become part of the program (Zimring et al., 2005 187). The implementation of the previous simple design efforts that captivate the user activity, in this case the smart use of stairs and levels, may help improve the health of the populations.

Therefore, we can assume that the design of an active space must be challenging and accessible at the same time. The circulation systems should be complex and dynamic, however with smart constraints or no constraints at all. The walking paths should disregard savings of space and material, and focus on the event and quality of the experience rather than efficiency. Stairs can be used to create new event spaces and to generate activity by presenting a more captivating experience and by being prioritized in the hierarchy of space (stairs should be more accessible and visible than the main elevators).

6. Further Analysis on the Interior Space and Active Design

The already explained internalizing effect of the modern society in correlation to the interior technologies, in other words, the mechanization and digitalization of the interior space, are not solely the problem that active design must solve. It may generate an opportunity for active design to expand through it. Instead of assuming that the contemporary house or sedentary behavior are the culprits of the problem, architects need to integrate creative solutions to adapt the space to activity. This chapter will define what features these spaces should enhance.

The mechanized and functional space which derived from the modern movement has little to no relation to the body needs of physical activity. The dogma of form follows function assumed that traditional space lacked functionality, and so it developed a purely utilitarian perspective of the space, aiming for the saving of physical movement and promoting instant gratification. Therefore, the space should be equipped with intentionally dysfunctional and abstract spaces that allow the body to move. That alone would be an incentive to increase physical activity by providing the means for movement.

Descartes argued that space was a material substance inseparable from the spatial extension of bodies. Newton and Leibniz debated the independence of space and the possibility of empty space in reference to bodies (Hensel 18). From this physicist perspective, time manifests itself in the space through the movement of bodies. Spatial fourth dimension is activated by our bodies movement. Body interaction within the built environment begins with walking and physical movement. It is by walking, while moving that one sees the development of the architectural order (Tafuri 24; Lerup 94). Also alluding to this Arnau states that: The interaction between body and space depend on the capacity of movement and exploration of this environment. When we move we create space around us: space that is corporal (Arnau 250).

To sum it up, the empty space is the generator of body movement. The empty space in relation to the body allows for the body to assimilate the space through its tactile sense. The architecture of Tadao Ando and most vernacular Japanese housing incorporates the essence of this notion of a predominant empty space, which is in fact the worshipping of the body in the house. The empty space is the space of endless possibilities of movement and activity. The following statement of Certau alludes to this notion: Far from expressing a void or describing a lack, it creates such. It makes room for a void. In that way, it opens up clearings; it "allows" a certain play within a system of defined places. It "authorizes" the production of an area of free play (Spielraum) on checkerboard that analyzes and classifies identities. It makes places habitable. On these grounds, I call such discourse a "local authority." It is a crack in the system that saturates places with signification and indeed so reduces them to this signification that it is impossible to breathe in them (Certeau 106). This helps support the notion of the empty space as the generator - of the event, understood as an indeterminate set of unexpected outcomes (Tschumi 2000 13).

Tadao Ando spaces are particularly concerned with the experiencing subject that he characterizes through the term *shintai*, the Japanese word for body. When “I” perceive the concrete to be something cold and hard, “I” recognize the body as something warm and soft. In this way the body in its dynamic relationship with the world becomes the *shintai*. It is only the *shintai* in this sense that builds or understands architecture. The *shintai* is a sentient being that responds to the world. When one stands on a site which is still empty, one can sometimes hear the land voice a need for a building (Dodds and Tavernor 305).

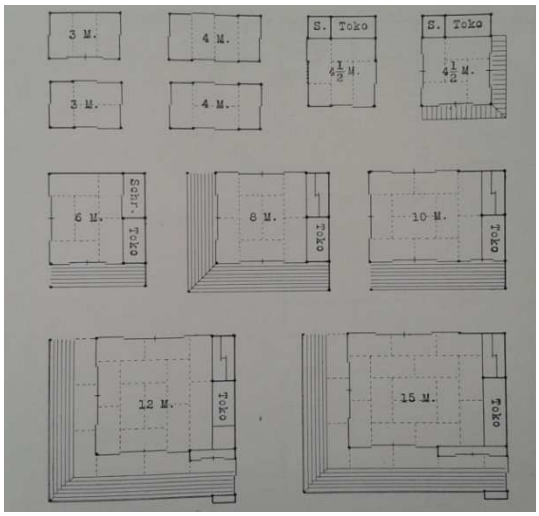
Another way in which the body seems to be inscribed in Ando’s architecture may be characterized as ritualistic to the extent that the subject’s passage through his architecture invariably involves a carefully orchestrated spatial itinerary, deriving from the Le Corbusier's concept of architectural promenade, Tadao Ando's empty space assumes a more phenomenological character (Dodds and Tavernor 306).

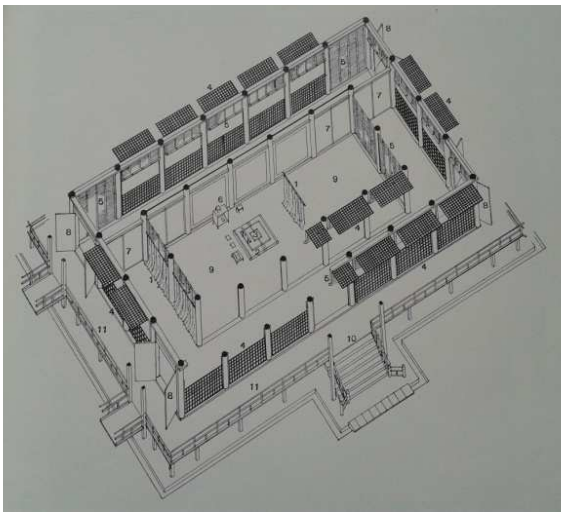
The empty space of the far-eastern spatial approaches is related to the metaphysical aspect of their culture, which is directly related to the body and recognizes the importance of mobility and meditation. The empty space is a subliminal element of their architecture that is of extreme importance to incorporate in the building because it aims for activity in respect to the body. This also relates to the concept already discussed on the obstacles and barriers in the space that condition body motion.

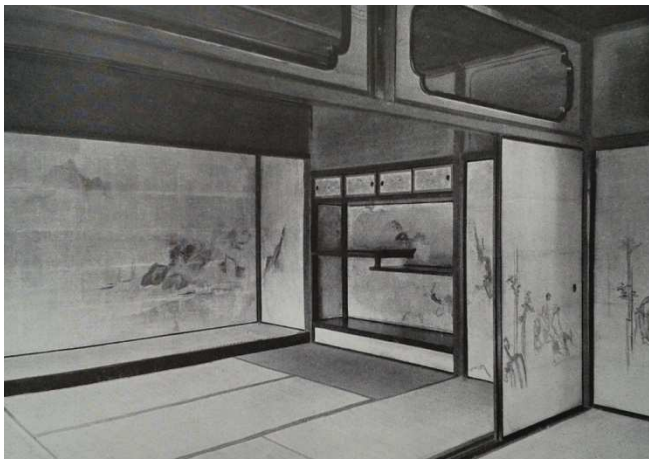
(Fig. 82) (Fig. 83) Tadao Ando and the traditional japanese empty space, tatami.

The open free space is a space that by itself is unclear of definition. It is by itself receptive to the idea of movement, for its lack of obstacles, if we consider that the imposition of objects in the space can be detrimental to human movement - when we consciously focus on a certain object, our body becomes more rigid (Bloomer and Moore 55).

However the open space without obstacles may be monotonous and lacks the challenge and dynamism of a space that strategically imposes them. In part, architecture aims to be primarily functional but active design must correspond to the natural body dynamics of movement. Active design should: utilizing Ando's words on his architectural context - remove architecture from function after ensuring the observation of functional basics. Architecture should first pursue function and then, after the pursuit has been made, architecture can be removed from function. Therefore, the significance of architecture is found in the distance between it and function (Ando 1980 45-46) and must be understood through the senses of the shintai (Ando 1988; Dodds and Tavernor 305).



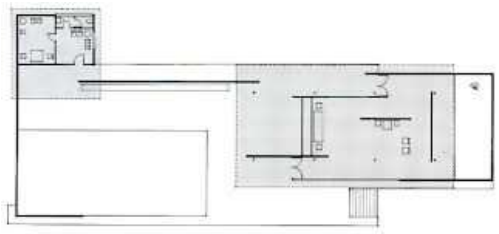




(Fig. 84)(Fig. 85(Fig. 86) Empty spaces in Japanese traditional architecture.

On the other hand, the spatial compositions of Mies Van der Rohe in part suggest the inverse of this previous discourse. Considering its deliberate establishment of a spatial system composed of barriers and obstacles. This imposition of walls and constraints are elements that control the user's body movements, nonetheless not necessarily restraining movement but generating possibilities. The words of Tschumi on the fragmented and articulated space also apply on the interpretation of Mies space: There is one sequence of direct vision and one for the experience of the body where a set of indeterminate and equivocal articulations suggests a multiplicity of readings. Its spatial sequence is nevertheless organized around a thematic structure, a series of variations around a limited number of elements play the role of the fundamental theme - the paradigm (Tschumi 1996 161). This multiplicity of spatial sequences generate event spaces, similar to the concept of the event spaces of Tschumi, however in a more passive and constrained manner.

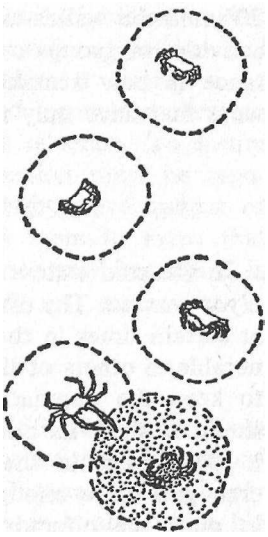
This observation serves to conclude that the smart control of the space through constraints is a positive effort towards active design, however it shoud not be overdone. As Peter Zumthor said: good architecture should receive the human visitor, should enable him to experience it and live in it, but it should not constantly talk to him (Zumthor 33). Therefore the movement between subjects and objects is activated in reverse by "projection": subjects "project" some aspect of themselves into the space they are viewing or into which they are moving (Marche 107). The space that accommodates movement should emphasize the planned path with fixed halting points, a family of spatial points linked by continuous movement (Tschumi 1996 155). In other words the activity of the space can be in part controlled by features of the space. However, the space should not overpower the user or overuse constraints and features that influence human behavior. For the overcrowding of the space with obstacles and barriers without a defined scope is the cause of inertia.



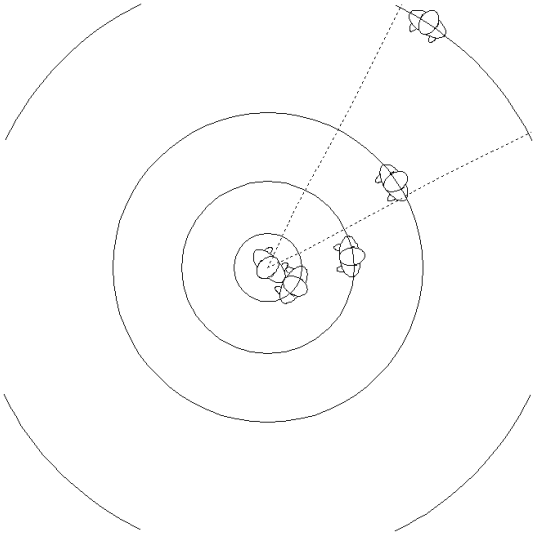
(Fig. 87) Mies Van der Rohe Barcelona Pavillion

controlled paths through the intersection of planes.

On this subject of the constrained space and the spatial configuration influence on individuals, nature is itself a metaphor. There are several examples of species reactions to the overcrowding of space and to the absence of empty space. Research has found that crabs are very peculiar in the way they interact with the environment. An interesting analysis by T. Hall (16), explains how these animals depend on the proximity in order to reproduce but will eventually self-destroy its own specie if the space becomes overcrowded. On the territoriality, birds and mammals not only define their territories which they occupy and defend against their own kind, but they have a series of uniform distances which they maintain from each other (Hall 113). This could be understood as a natural example of aversion to the lack of space, where the bodies do not tolerate and react when constrained. However, this reaction on humans is a rare phenomenon, as the human bodies tend to tolerate and adapt a myriad of adverse conditions and spatial constraints, the human bodies react psychologically and physically when the space lacks openness and fluidity through health problems already stated in this study.



(Fig. 88) Crab territorial behavior. T. Hall.



(Fig. 89) Human space perception according to T. Hall.

Therefore, when the space prioritizes plainness instead of prioritizing constrains and obstacles, that constitutes a positive effort in the direction of the active space. The interior active space should be empty as possible in order to afford action and movement, an idea which seems to be present in the minimalistic approaches. To reassert this argument, we can assume that the emptiness of the space is related to the human perception of the space through the five senses. These five senses along cause psychological determinants that affect an individual's sense of mobility in the space. The sense of stability is primordial in encouraging movement.

The emotional and sensorial status of the individual is preponderant in defining how active his tasks will be. In order to enhance such properties, designers should collaborate with environmental psychologists, industrial designers, engineers, and architects, to explore how physical activity might be encouraged through design and technology within the interior space and to identify potential intervention strategies to encourage greater activity (Wells et al., 15). Architecture should gather information from different areas in order to better define the moving space program, as there is no architecture without program, and no architecture without movement (Tschumi 2000 16).

Movement is an activity that requires free appropriation of the space by the human senses, it is directly related to the suppression of obstacles and unpredictable barriers, this may include walls, doors and structural elements. Although all the senses play an important role in the activity of the space the visual and tactile are the most important. On this concern research has found that we feel pleasure and protection when the body discovers its resonance in space (emptiness) (Pallasmaa 2006 36). Similarly to T. Hall theory of the space, I can assume that dark spaces instinctively turn human behavior into a defensive stance. The scale of the room also plays an important role on the behavior of the occupant, a space which is too small might induce a sense claustrophobia and impair the sense of movement, a space which is too big and wide might suggest agoraphobia discouraging the occupant will to move.

Moreover, Hall defined four different categories of spatial dimensions relating to the human body interaction in the space. The intimate space, the personal space, the social space and the public space. The public space varies from 300 cms to 660 cms. Considering the house as a micro-city (Guallart and Cantarella 30) where the human body performs several tasks that were before reserved for the public area, this empty space should incorporate a methodology that values the house as if it was a simulation of the exterior (Rolex Learning Center). In order to unconstraint and disinhibit the physical sense, the interior space should be equipped with several of these spaces which allow for movement, within the same range in radius.

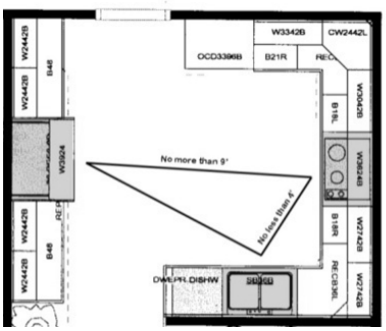
Further on this subject of the empty space, there is the concept of strong and weak program buildings. According to Craig Zimring, the strong program buildings are destined to a small range of activities and its intended to support specific functions, such as hospitals, courthouses and prisons. These building spaces constrain the occupant's freedom of movement and limits the function and flexibility. The weak program buildings are spaces where a wide range of actions can take place without major

changes on its spatial configuration. These buildings allow for more freedom of circulation and less restriction on the functional criteria of the space, generating spaces that can adapt to new circumstances and occupant behavior, such as, museums and art galleries (Zimring et al., 2005 187). Interestingly, the majority of the examples analyzed on this study are weak program buildings, corresponding to the buildings with more potential for activity.

Environment influences behavior, therefore a constrained space will generate constrained behaviors. Bringing a strong program building into perspective we can clearly distinguish it from a weak program building by its unavailability of free empty space. It becomes evident again that this empty space is the key for movement and flexibility in the interior space. The house should integrate more of these spaces and distribute them as event spaces within the circulation and where the main activities take place.

The strong programs often standardize the movement of our bodies in the space, allowing for less freedom of movement and less motivational impetus. It has also been suggested that the central location of exercise and activity areas, and the presence of wide, unobstructed circulation corridors with seating at regular intervals supports active behavior (Parker and Joseph 2003; Zimring et al., 2005 190). The space should be flexible and clean without the priority of saving in user movement and instant functionality.[6] The speed of the body affects the experience of the space; the space narrows into a corridor, limiting the body's awareness of what lies behind or beside (Jormakka 76), therefore reducing human speed.

The Cornell triangle is a spatial study on the geometry of the kitchen by Martha Van Rensselaer for the purpose of saving steps of the users (Wells et al., 14). Although the strategy is to improve functionality and efficiency, the optimized approach may reduce the activity of the user when the intention of active design is to improve it. However the Cornell triangle generates an interesting circulation space and empty area that is not exactly constraining nor debilitating to body motion.



(Fig. 90) Example of Cornell Kitchen Triangle as an example for moving space necessary within the home.

[6] Instant functionality is what I define as the function that allows for instant responses from the environment with effortless movement from the user.

Rather than the floors, it is the elements of circulation which are given form, and as holes that punch through walls, these voids capture the figured energy of the project (Eisenman 2008). By creating these voids inside the interior space, the user is presented with constant empty spaces which are active friendly. The objective of creating active environments is not a question of forcing the users to move and walk, but to influence their behavior, increase the access to these spaces and provide the spatial criteria that eventually can encourage physical activity, such as through an active approach on the spatial hierarchy. Reasserting the following citation: Behavioral choice theory suggests that environmental changes that both increase the proximity and convenience of physical activity and decrease access to sedentary activities can increase physical activity (Epstein and Roemmich 103-08; Epstein 1998 6, 262).

This study can assume that functionality should not be a priority in the state of the problem relating to active design. However, an active functionality can be approached, but it is hard to define the laws of a space that enhance activity and stimulate users, when these laws are a blend that result from the deconstruction of the function.

Referring to the paragraph of the building programs, the design should pursue a weak building program, characterized for its availability of space and freedom of circulation as well as flexibility and dynamic transitions between the so called event spaces. The building should be equipped with multiple paths, and should provide the user a few different active choices which are to be prioritized over the passive choices in the hierarchy of the space. The interior can incorporate a plaza-like spaces that serve no purpose other than physical activity, utilitarian movement, event spaces or even rest spaces. The building and the interior space should pursue an approach of a micro-city or as a metaphor of the exterior environment with rich capacity of movement and various possibilities.

7. Home Active Design

7.1 Introduction - the Digitalization of the Space

Originally, the house was not equipped with the same technological apparatus as today. It is of common knowledge that it only had the function of individual protection and shelter. The activity of the house was centered around static functions, such as sleeping and resting. Most of the leisure activities and play spaces were outside of the house. In the modern times the house started the incorporation of work and leisure activities in its program. This alienated the interaction of body and space and resulted in the minimalistic and functional embodied experience internalized in the house. As consequence, human activity became minimized and constrained in the interior space, which has gradually transformed into a digital micro-city that can simulate living experience. What strategies can be adopted to enhance an active space in the digitalized home in conjunction with the technologies of the contemporary age?

The house evolved into a multidisciplinary space filled with a myriad of technological components which have expanded its function and increased the time spent at home by the users. In the XIX century, the piping of water into the home led to the appearance of the kitchen and the bathroom; in the XX century, artificial light and electricity resulted in new forms of domestic organization; household appliances allowed people to conserve food for longer periods and to do more in less time, and TV turned the traditional living room into a window onto a world dominated by the mass media (Guallart and Cantarella 30). In the modern times, knowledge and experience became a process of assimilation of information through screens, where human bodies absorb information and experience in a similar way the computer shares data. In the modern concept of space and lifestyle, the body lives for the most in a static position protected from its full interaction with the environment. The design of the home in the information age has gone through a number of different models as the paradigm of the technologies of information and communication has evolved since the 1940s (Guallart and Cantarella 33). Since the development of audiovisual electronic media in the 1950s, they have always been visible on television screens, and later on, in computers in a domestic environment. (…) A large amount of free leisure time at home started revolving around the TV or the computer (Guallart and Cantarella 148).

While in feudal military society houses were castles and walled cities, and in an industrial society, stores of domestic appliances and rooms for watching TV in, in a digital society people will want their house to be a networked computer (Guallart and Cantarella 32). These technologies have internalized socialization, entertainment and work functions at home, allowing for the individuals to live without the immediate need to leave the house. This phenomenon is related in our times to the wide use of the internet at home, which has transformed the house into a micro-city, where users can communicate and access entertainment without leaving the house. Supporting this notion Guallart and Cantarella

stated the following: if work, play, shopping and rest time are conducted in the home, is the home a micro city (Guallart and Cantarella 46)? Every age has produced a particular way of dwelling as a reflection of technological developments. However, in our own time, the new technologies of information and communications are transforming the home into a micro-city, a genuinely multifunctional environment (complete with work, shopping, leisure, and rest) from which to inhabit the global village (Guallart and Cantarella 30). Our domicile became the refuge of our body memory and identity (Pallasmaa 2006 35).

These technologies greatly contributed to a shift in our society. This shift has mostly influenced our inside and outside activity causing our bodies to act sedentarily. The outside images were reproduced in the screen, so that the user no longer needed to leave the house to access these images or these places. The house became a more complete space for the user being elevated to this status of a digital micro-city which has yet neglected the function of movement and spontaneity of the outside space, and obviously it cannot replace the physical activity offered in the exterior. This caused a behavior associated with obesity, which is found in residences (filled with electronic entertainment and labor-saving devices), workplaces (sitting at a desk), sports venues (where the vast majority sits and watches others move around), schools, and roadways built to optimize travel by car (Glanz and Sallis, 2009). Therefore if the house became the prominent living space, active design consider not only the different exterior and building environments where humans move and interact, but it should also take into account the work and home space where humans spend most of their time - the digitalized home.

The history of the bodily analogy in architecture, from Vitruvius to the present, might be described in one sense as the progressive distancing of the body from the building, a gradual extension of the anthropomorphic analogy into wider and wider domains leading inexorably to the final "loss" of the body as an authoritative foundation for architecture (Vidler 70).[7] Heidegger has defined the increased importance of the visual sense as one of the great shifts in the beginning of the modern era, referring it as the "conquest of the world as picture". What was before the physical criteria that built houses and our interior space was replaced by a visual criteria. So, architecture became too a product of this visual revolution of the XX century, which established the visual sense above all the other body senses. In both theory and practice, the media's potential effect on space has become a catalyst for contemporary architectural innovation and experimentation … society is now about media and mediation, making us aware that the direction taken by technology is less the domination of nature through technology than the development of information and the construction of the world as a set of "images." (Tschumi 1996 245) However, the architectural experience and human relation with the built environment is primarily a tactile experience and - architecture is itself a reflection of the features of the human body (Bloomer and Moore 27). A bodily reaction is an inseparable aspect of the experience of architecture as a consequence of this implied action. A real architectural experience is not simply a

[7] However, this referred to the body of the adult man, it disregarded the body of the women, children and the elderly.

series of retinal images; a building is encountered - it is approached, confronted, encountered, related to one's body, moved, about, utilized as a condition for other things, etc (Pallasmaa 2006 35).

(Fig. 91)(Fig. 92)(Fig. 93 Iconic photographs of the XX century. "The conquest of the world as picture."

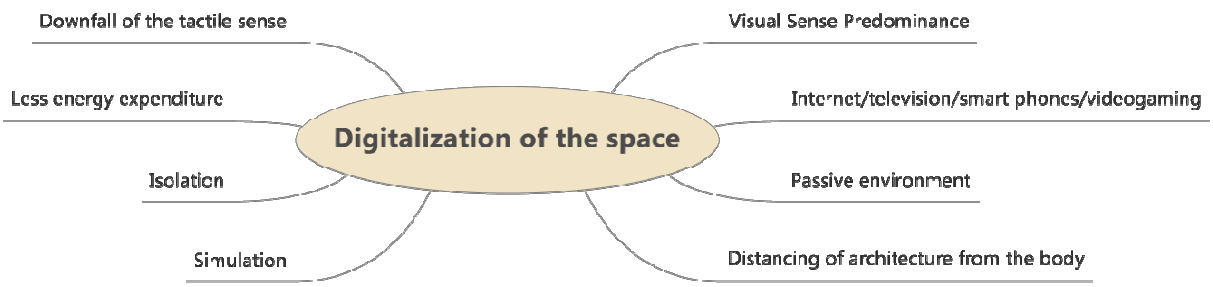
The television became the most absorbing element of the home, which consumed most of the time spent at home and in part recreated social interaction. The reality shows and soap operas offer a sense of illusion of social connection, allowing the users to feel artificially social without leaving the house. Moreover, with the internet, the user became convinced of his own power of choice, therefore often replaced the direct outside experience for the internet immediate responsiveness and interactive experience. Yet, considering its many benefits, this virtual life simulation neglects the need for physical contact and expression of the human being in the environment.

The obsession with technology at home is taken to life threatening situations of psychological disorders such as in the very recent hikikomori phenomenon.[8] This internalizing effect not only neglects the direct experience and all the other senses which the body was made to experience, it dramatically affects physical activity and health in general, replacing human movement by digital navigation.

The machine and the human body have always been connected through the event, and the nature of this connection has attained a new degree of sophistication and complexity as bodies are increasingly reshaped by technology (Girard 98). The machine and technology finally became an element of our homes capable of replacing the cinema, the theater, social activity and support academic and work related activities. However it still cannot replace the human need for physical activity.

[8] Hikikomori is a home reclusive phenomenon related to the extreme use and dependency of the internet and video gaming.

(Fig. 94) (Fig. 95) The hikikomori phenomenon.



(Fig. 96) The digitalization of the space synthesis.

7.2 The House as the Contemporary Fortress of the Body

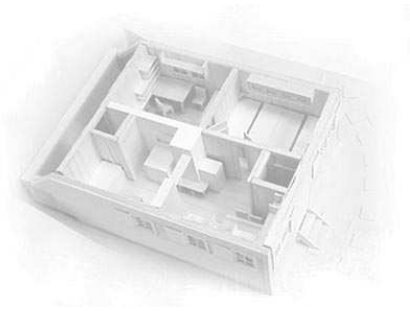
With the rise of the 20th century technologies, the home became a space of internalized exterior functions, achieving this status of a micro-city for its increased autonomy. The rise of this autonomy along with the individualism has finally transformed the house into a place that could be completely detached from the city, but providing everything the individual needs.

The hikikomori phenomenon and the internalizing effect are the result of the rise of individualism which is deeply connected with the modern technologies. This allowed for peculiar architectures to flourish which are of great importance to this research. The automobile started the conquest of a significant space in the modern city and lifestyle. This among other inventions and technologies triggered the rise and prevalence of individualism above collectivism.

In 1916, the Ford T model was commercialized and designed to be economically accessible to the middle class, allowing for the masses to acquire it. This further influenced the post-second world war rise of the suburbia in the United States, where the war veterans moved to the suburbs of the city, event that was only practicable with a technology such as the automobile. The car was crucial to allow the isolation of communities from the main urban areas, therefore increasing the autonomy of the house.

(Fig. 97) Ford model T.

This is an important context consider in order to understand that individualism is the result of modern technologies, and this also influenced the perception of the house as the ultimate fortress of the individual. In Heidegger's Hut of Adam Sharr it describes an isolated space specifically built for the purpose of reading, thinking and writing. The relationship between the philosopher Heidegger and nature in connection with the relation of the house and its surroundings, the house provides an hermit like environment for the sole purpose of reflection. During his career he retired several times from his obligations whenever it was possible and when he needed to concentrate. There he elaborated many of his most famous philosophical works (Sharr 55). In cases such as this, particularly in the contemporary age the individual isolates himself and interprets the house as his microcosmos.

(Fig. 98) (Fig. 99) Heidegger's hut picture and model.

Also following this concern, the Melnikov's house is an architecture that is related to this isolation phenomenon. Having been linked to Melnikov's personal problems, it is an example of a space conceived for the individual to isolate himself from the external environment, providing most of the spaces for the main necessary activities. The following statements of Pallasmaa allude to this notion: Melnikov's house expresses the redemptive mission of architecture, appearing to have a metaphysical task beyond its utilitarian residential function (...) The personal tragedy of the architect hovers around the house; Melnikov lived in this house for forty-five years altogether, until his death in 1974, but in 1937, at the age of forty-seven, he was banned from practising his profession (Pallasmaa, The Melnikov House 7). In the Soviet state of surveillance, the home was turned into a prison, and Melnikov himself was confined to his Utopia for the rest of his life. Faced with the inertia of conservatism at the core of the revolutionary movement itself, he found himself leading a largely conventional Moscovite life inside his image of cosmic architecture (Pallasmaa, The Melnikov House 24).

Although Melnikov's case is an early modern example of isolation, the phenomenon of isolation in the contemporary age is related to the internalization of external functions and the rise of home technologies and appliances. This internalizing effect is therefore the essence of sedentary lifestyles,

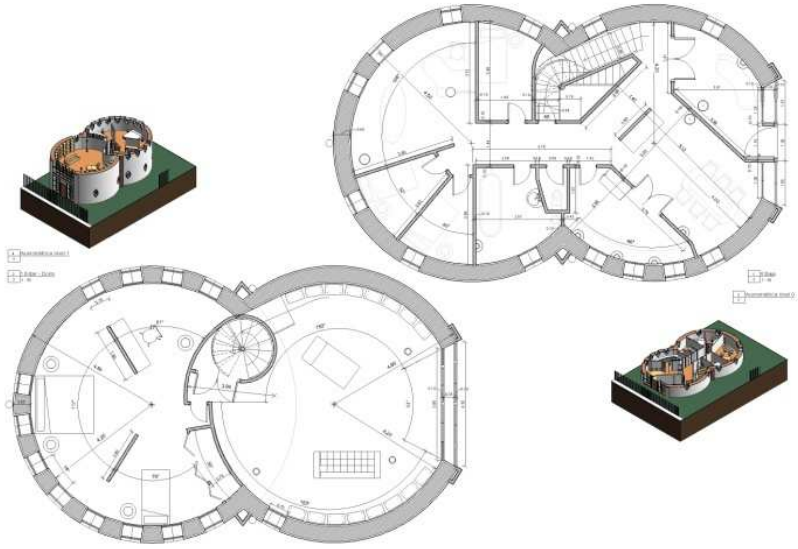
which in turn are related to physical and mental health problems. In the case of Melnikov's condition was of external social and political problems. However it is still an interesting space to be considered as an early attempt of isolation and autonomous model, or an early model of a micro-city with leisure and work components incorporated in the house - that becomes an instrument with which to confront the cosmos (Bachelard 46). Though, Melnikov's house attempts to create a space that serves the human being in its entirety aiming for the modernization and humanization of the space, and implicitly to the concept of "dwelling as desiring machine" (Wortmann 81).

The following statement of Wortmann supports this notion of the house as a place of autonomy and protection from the outside world: The house is a space that serves the ego of the inhabitant, escaping the static concept of the house as a place to rest and lay, to incorporate work and leisure functions. As Melnikov said in his later autobiography "... to be free at least once in my life! To combine in one person the function of the architect and client, I decided to build myself a house...". The "feeling at home in the world" and the activity with which an individual registers" himself in his environment (Wortmann 85).

The interesting thing about Melnikov's house is that it tries to withdraw from the static nature of that stability in favor of a "meta-stable" situation, which arises in alienation. In such a process, the architecture of the house forms merely the matrix of the activity of dwelling. Dwelling cannot be contained within an architectural form as house, but must be constantly produced by the occupier (Wortmann 87). It is in fact, the place for alienation by analogy, where the conscious and the uncouncious fertilize each other in order to create dreams, but also dynamic creativity. As the 8-form of the ground plan seems to symbolize, it is a house of endless movement, a Mobius strip circling round the two focal points of an ellipse, whereby inside and outside, open and closed, constantly invert themselves. (Wortmann 101). The element of movement is again present. "...the product dwelling, the production dwelling and the consumption dwelling are one and the same, and the desire to dwell, is the eminent principle of this closed process." The house of Melnikov is an architecture of leisure, production and consumption - a new convention in architecture at the time. The Melnikov house is a symbol of the unending struggle between archaic and the futuristic in modernity. It is a proof of the depth and strenght of an authentic architectural idea (...) enduring both physical erosion and mental neglect (Pallasmaa, The Melnikov House 24). Further could be said on the work space of the house which was destined for his painting activities. This studio was an empty room providing a central space for Melnikov's daily activities.

This short reflection refers to the precedence of the contemporary house as an isolated space, where individuals spend most of their time. The house could now become in fact an autonomous and isolated environment as it partially serves most of the human needs of entertainment and social interaction, still it hardly answers the need of human physical movement. The fact that the house is a limited space for limited movement, makes me conclude that the possibilities of activity are rather limited, if not enhanced by technological apparatus or simulation.

(Fig. 100) Melnikov house empty space studio.



(Fig. 101) Fig. Melnikov house plans.

7.3 Home Technological Active Design

Modern architecture started the concept of the house for the individual. A place that can be self-sufficient and isolated from the surroundings by internalizing technological components and external activities. However this notions still ignored the fact that the human body still needed physical activity in order to thrive. The notion explored in this thesis, that architecture should be a tactile physical experience, which does not always imply the functionally convenient, or - the ideal of the perfectly functional house, the modern machine for dwelling that aims at eliminating discomfort and friction, when the realization of the self within the world implies a confrontation (Pallasmaa, The Melnikov House 24).

Having in account this isolation phenomenon (which is connected to the desire for activity inside the house), knowing that the modern human being became less outgoing, that physical inactivity is clearly related to the hours spent in sedentary activities mainly in sitting position, this study assumes that this situation could improve if an embedded system of leisure activity and virtual reality could be combined with physical activity. The concept of home active space is supported by Papas and Gebel: Designers must evaluate all varieties of the built environment to which humans are exposed across their lives. This includes consideration of both residential space and activity space, as well as the connection between these spheres (Papas, et al., 130). To increase physical activity in the residential space there is a priority to optimize the space into the activities that can be used to stimulate movement. Some of the activities that can be optimized are called unstructured activities which encompass a more broad description of lifestyle activities undertaken in different domains including domestic work, or work which can incorporates physical activities (Gebel et al., 13).

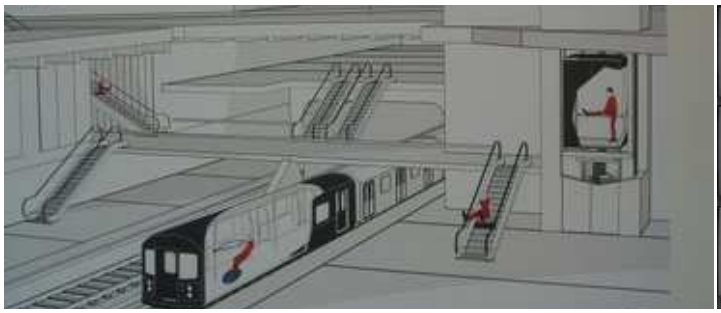
Most of these unstructured activities which take place in the interior space are related to leisure or house work. The digitalization of the space, which results in sedentary activity can be reinterpreted in order to allow for more activity-friendly environments. An home active space would contribute significantly to child health improvements.

If the visual sense became the priority of the modern and contemporary age, further research on the interactivity of this sense and home leisure would provide an opportunity to physical activity. This can be based on smart technologies and intelligent spaces which can replace the current static interaction of the body and the space. The intelligent space is a denomination that encompasses several initiatives for creating an environment that is continuously tracking and sensing people and objects within a physical space while offering some type of feedback or help. These technologies are already available and are being tested for their many possibilities. The smart rooms were a development at MIT that try to mimic physical spaces in the virtual one and bridge both of them by means of huge projection screens (Guallart and Cantarella 88).

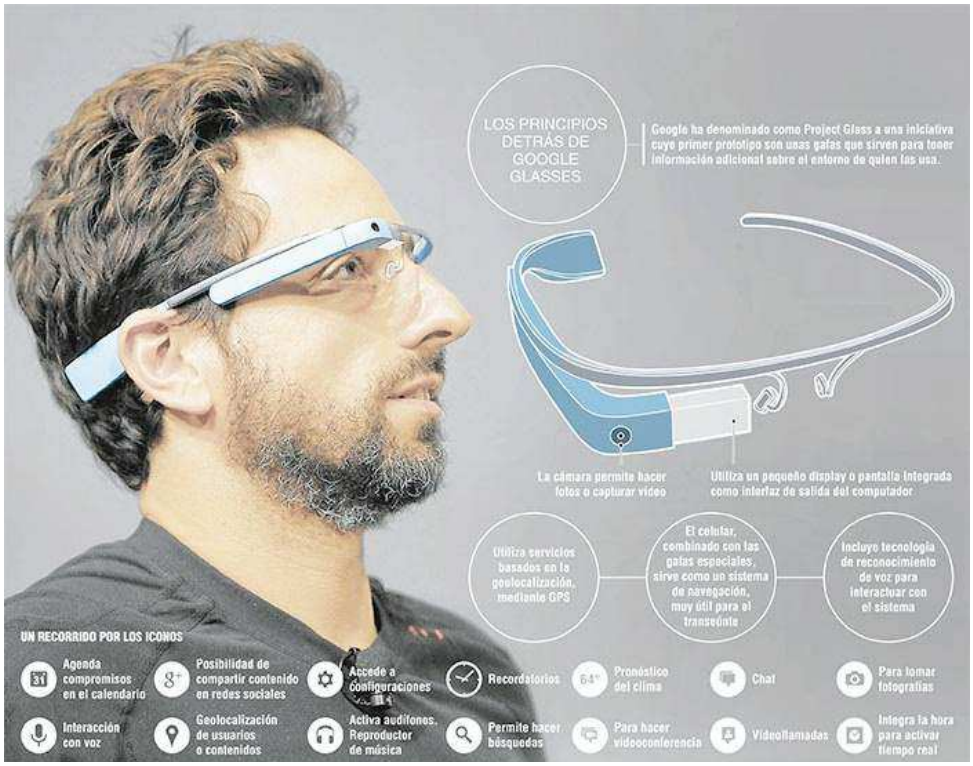
There a several examples of smart technology approaches to stimulate activity in the space. In 2009 Volkswagen has created a concept to encourage the use of stairs by transforming the steps into piano keys. As the user climbs the stairs, the piano plays.

(Fig. 102) Volkswagen piano stairs.

Artist Antal Lakner invented the concept of INERS, in which people could use the interior space components for physical activity. Research has found that by stretching in the elevator, paragliding on escalators, and tunnel surfing in subways as an alternative means for training in moving spaces for speed-paralyzed urban passengers in an ever-accelerating world. These activities attempt to remobilize men who have been rendered passive and even paralyzed in an ever-accelerating world (Wizen and Fritz 170).



(Fig. 103) (Fig. 104) Iners tunnel surfing and elevator stretching.



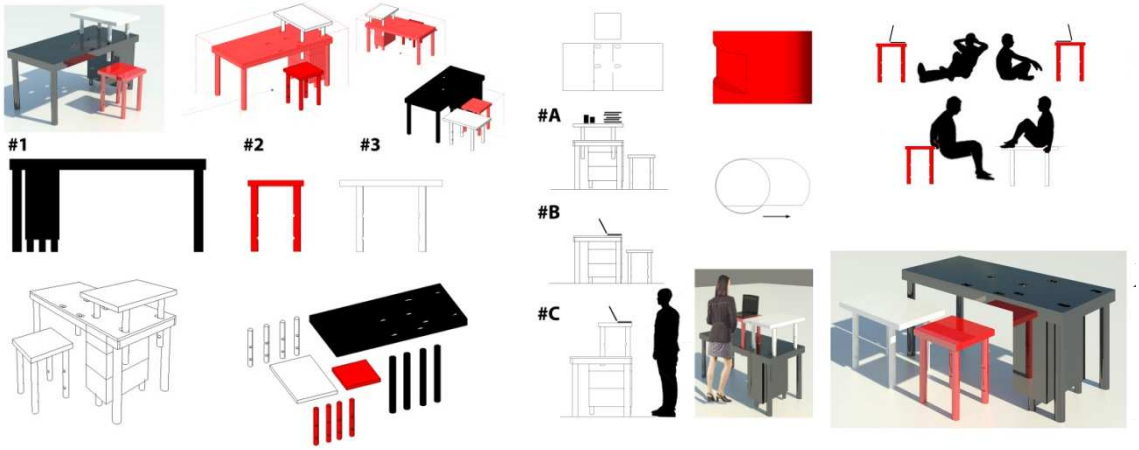
(Fig. 105) Googles Glasses. Allow for interactivity with the virtual world while walking or exercising.

The objective of this study is not to demonize technologies, but to have in account the natural dynamics of the human body, its need for movement. To considered the body in the built environment and in the design approaches will benefit the general health of the populations. Home environment can adapt technologies for active purposes if not for simple human micro-movement or to discourage excessive sitting. Excessive sitting is detrimental to health whether individuals perform daily physical exercise or not. As the body sits on a chair, the electrical activity in the muscles drops leading to a cascade of harmful metabolic effects. The body's calorie burning rate immediately plunges to about one per minute, a third of what it would be if you got up and walked - The NEAT concept: Non-Exercise Activity Thermogenesis, states that even the little movements while sitting can affect one's calorie burning (Vlahos 2011). A positive improvement would be to encourage the standing position for certain amount of time per day, and increasing the walkability of the user through an approach that generated a walking path and motivated it through design, as the physical design of the places where people live affects their overall how much they walk (Lawrence, Andresen and Schmid 2). The author of this study has designed two active-friendly pieces of furniture for the course of *Diseño de Mobiliario*, at *Universidad Politecnica de Madrid* in 2013. See (fig.109) (fig.110). These two models are directed to the effort of reducing the excessive sitting by encouraging the standing position.

(Fig. 106) Micro movement chair.

(Fig. 107) Classic architect work desk.

(Fig. 108) Standing position ergonomics.



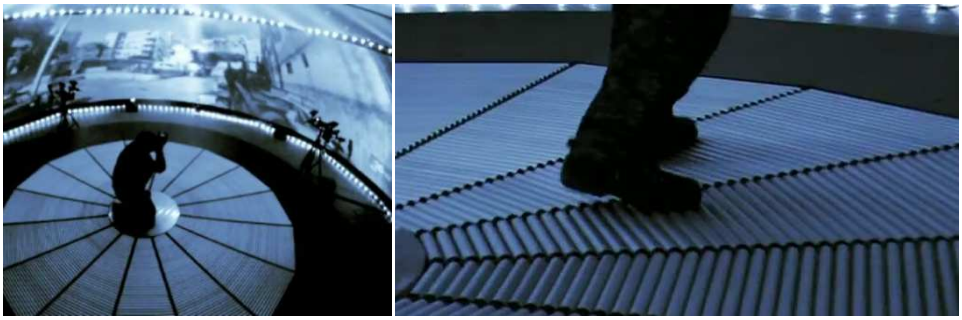
(Fig. 109) Austere furniture.

(Fig. 110) Austere furniture 2.

Within a few years, the passive physical world defined by purely functional structure which give people shelter, and in which we consume products and interact with the world by way of screens, will be rendered obsolete by intelligent environments (…) Architecture, which organizes human activity by means of the construction of space, has the potential to play a key role in this new, hybrid situation by redefining itself as an interface for interaction (Guallart and Cantarella 30). With the increase of technologies that inhibit physical movement, the final question of this thesis is, how can we still encourage movement in our lifestyles through design and technology? How can we keep our bodies active in a city and in houses which functions were first thought for the non-human means of movement? Through the design of spaces that incorporate smart technologies that interact with the body.

The following images present an experimental technology developed by the Swedish company MSE Weibull, for an active interaction of the body and virtual gaming. It allows for the user to have a complete physically active experience with the virtual environment, allowing omni-directional movement and live experience. This technology could be integrated in specific space of the house and could eventually turn video gaming into an active experience reducing obesity and improving the health of the young individuals. This virtual theatre system facilitates omni-directional unrestricted walking in the infinite virtual environment, within a finite real world footprint. With physical and potentially psychological strain, the training effect is raised (MSE Weibull n.d.).

The concept follows the previously explained idea of the utilitarian active design, where active features of the space have another intrinsic advantage when it comes to promoting physical activity (King et al., 2002 22), and if movement for exercise and recreation and movement for pleasure are likely highly correlated, as enjoyment is often a key attribute and purpose for choosing particular recreational activities (Owen, et al., 69), then the home environment should incorporate smart environments that allow physical activity. These smart technologies will eventually become the next appliance to be incorporated in the home space - the knowledge society will develop a home geared towards the creation and representation, in which the individual, the citizen in relation with other citizens around the world, can live a life of improved quality (Guallart and Cantarella 30). This seems to counterbalance the effect of sedentarization of technologies.



(Fig. 111) Omni-threadmill. Physical activity within the virtual simulation home.

This omni-treadmill is based on the omnidirectional floor. It may be configured with optional add-ons, such as a the following: Visual (360 degrees seamless projection); Audio (surround sound system); Motion (platform for Z, pitch, roll and vibration) Thermal (heating and cooling); Wind, smoke, flash, heat radiation; Body tracking (unlimited number of positions/segments with highest accuracy). Also, it is designed to be integrated in any application, with open interfaces. Some of the applications of these omni-treadmill are: Small arms trainers and military training; Firefighting trainers; Escape and evacuation; Gaming; Human factors research (MSE Weibull n.d.). If this technology has these different applications, it certainly can develop programs that are oriented for weight loss and fitness.

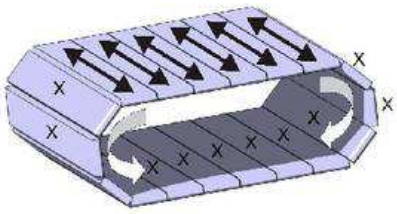
(Fig. 112) MSE Weibull omni-threadmill.

The virtusphere is another promising technology that allows for movement simulation in the home environment. The virtusphere consists of a 10-foot hollow sphere, which is placed on a special platform that allows the sphere to rotate freely in any direction according to the user's steps. A user is able to walk and run inside the sphere, viewing the virtual environment through the head-mounted display. The sensors collect and send data to the computer in real time and user's movement is replicated within the virtual environment (Virtusphere 2013).

The virtusphere is a device that allows a user to walk/run in a natural way within any virtual environment. Virtusphere consists of three independent components: mechanics, electronics and software applications, which can also be used independently of each other. However, when used simultaneously they produce the effect of complete and total immersion into virtual reality (Virtusphere 2013). This technology is an omnidirectional treadmill in the shape of a large sphere within which a user is able to walk/run (human equivalent of a hamster ball). The sphere is mounted on a special wheeled platform which allows the sphere to freely rotate around its center. Since the sphere is an endless folded plane, a user can walk/run inside of it in any direction for any distance. An image of virtual space is provided by a computer (console) combined with the data collected by the sensors that track the user's movement in real time. Depending on the application, the virtusphere can be supplemented with various sensors and devices. A software application provides a content component of the virtual space. Thereafter, a software application determines the functional use of the virtusphere. When used for training purposes the virtusphere plays a role of and is referred to as a simulator, and when used with video game applications virtusphere can be referred to as a playstation (Virtusphere 2013).



(Fig. 113) (Fig. 114) (Fig. 115) Virtusphere.

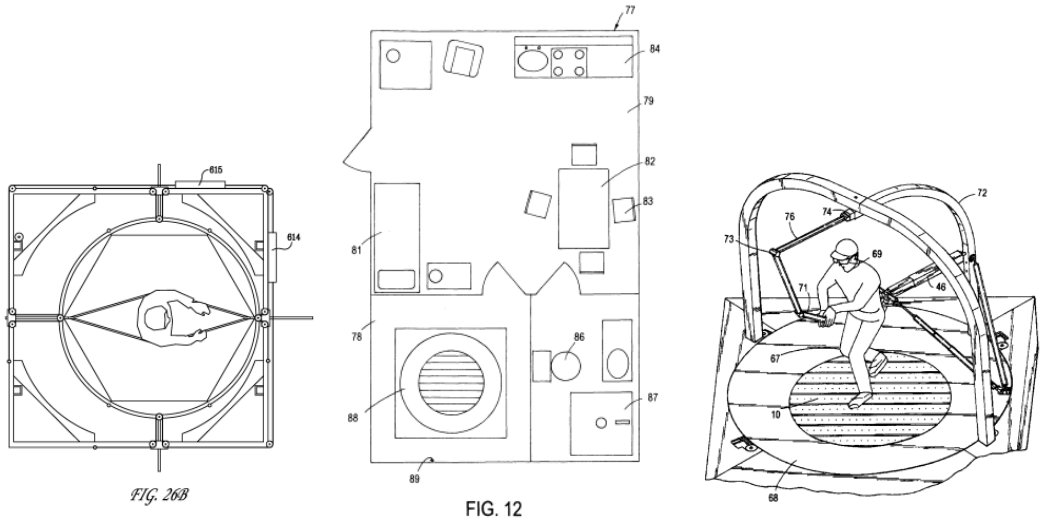




(Fig. 116)(Fig. 117) Cyberwalk treadmill.

(Fig. 118) Virtuix Omni.

The cyberwalk is another treadmill that has the same potential of improving physical activity in the interior space, enabling quasi-natural, unconstrained, and omni-directional walking in virtual worlds. cyberwalk approach will also prove relevant to many other application areas such as medical treatment and rehabilitation (Parkinson's disease, phobia, etc.), entertainment, sports (training facilities, fitness centers), behavioural science, education, training (maintenance teams, security guards, etc.), and architecture (exploring large virtual construction sites) (Technische Universität München, para.6)

And finally the Virtuix Omni is the smallest and cheapest technology available for this effect. It consists on a small platform and an harness that senses body movement. The Omni will free gamers from passive, seated gameplay, unleashing the full potential of virtual reality gaming with the Oculus Rift and future head mounted displays. Gaming on a keyboard, mouse or gamepad while seated cannot be compared to the intense experience and fun that comes from actually walking, running, and jumping in games (Virtuix Omni 2013).



(Fig. 119) (Fig. 120) (Fig. 121) Omni threadmill active space.

Other potential active technologies are already available such as the wii console. Just Dance is a game where the user interacts physically with the screen through dancing. In one hour of Just Dance users are expected to consume 380 calories (Fitness Blender 2013).

These technologies could radically increase the human caloric consumption and make individuals more active. If we consider that for humans to keep an healthy diet need to eat 2000 calories a day (U.S. Deparment of Health, FDA, 2013), and that depending on age, weight and gender we expend an amount of aproximately 1000-2000 kcal (BMI Calculator 2013; Creek 2001) without vigorous physical

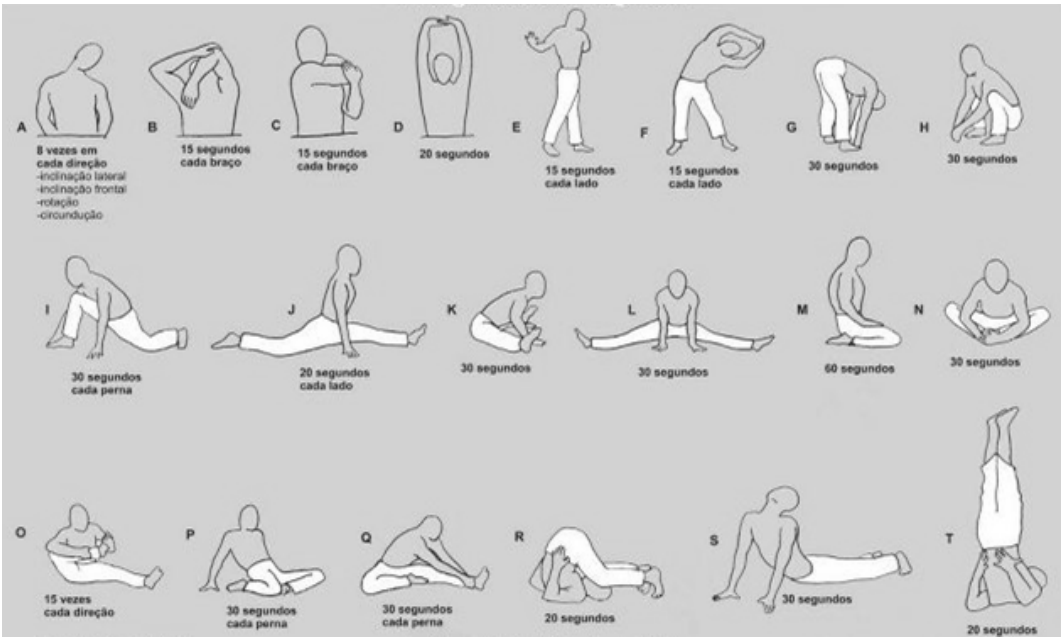
exercise. Daily home activities can consume an aproximate ammount of 500 calories, see (fig.122). Then it would not be necessary much more than 30 minutes to one hour of physical activity to balance the necessary daily caloric expenditure and keep the body healthy. If the house were to incorporate these solutions the physical activity problem in the interior space could be in part solved.

Home activities calories	**15 mins**	**1 hour**
Carpet sweeping, sweeping floors	39	156
Multiple household tasks, light	26	102
Cleaning, house or cabin, general	34	136
Washing dishes While standing	22	88
Cooking or food preparation	26	102
Putting away groceries	26	102
Specifically, carrying groceries	111	442
Carrying groceries upstairs	22	88
Home tasks, hygiene.	22	88
Sitting - Watching tv or other	9	34
Making the bed	18	68
Standing - light activity	17	68
Serving food, setting table	26	102
Watering plants	26	102

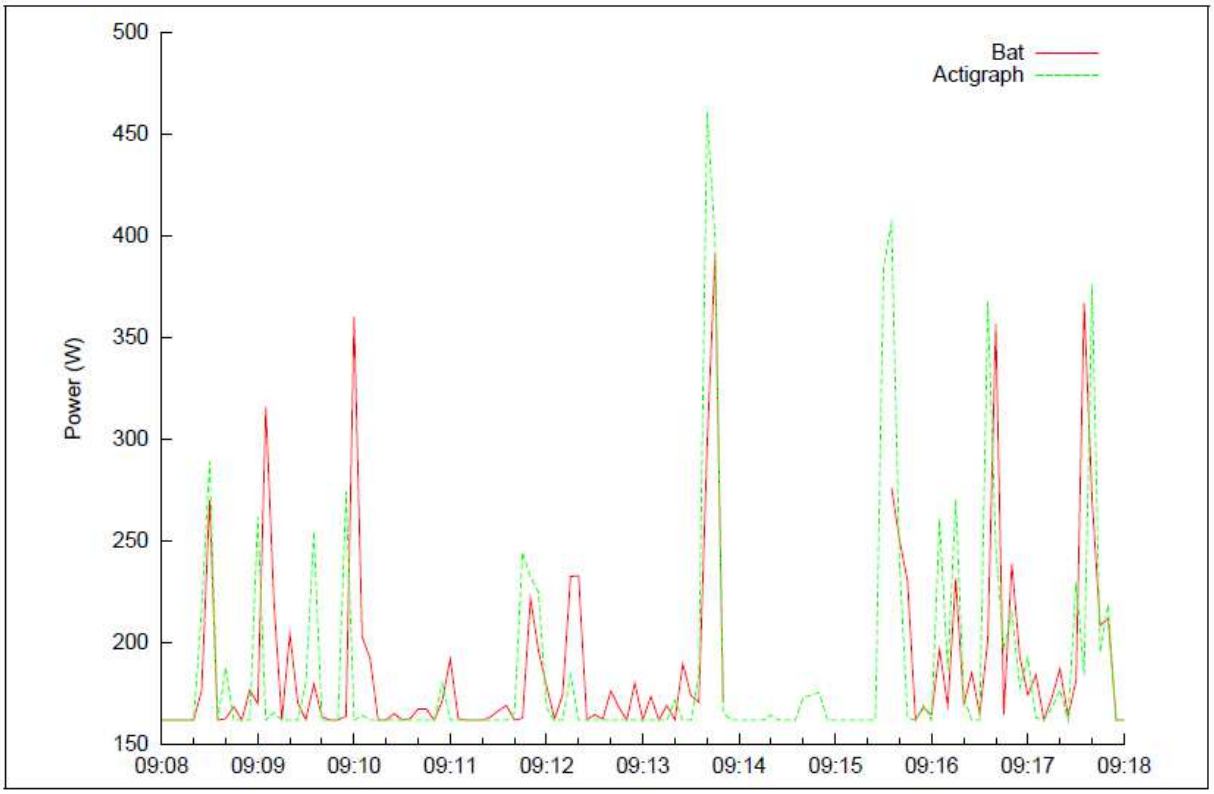
(Fig. 122) Caloric consumption of daily home basic activities.

(Fig. 123) Work activity concealed with active design. Utilitarian active design.

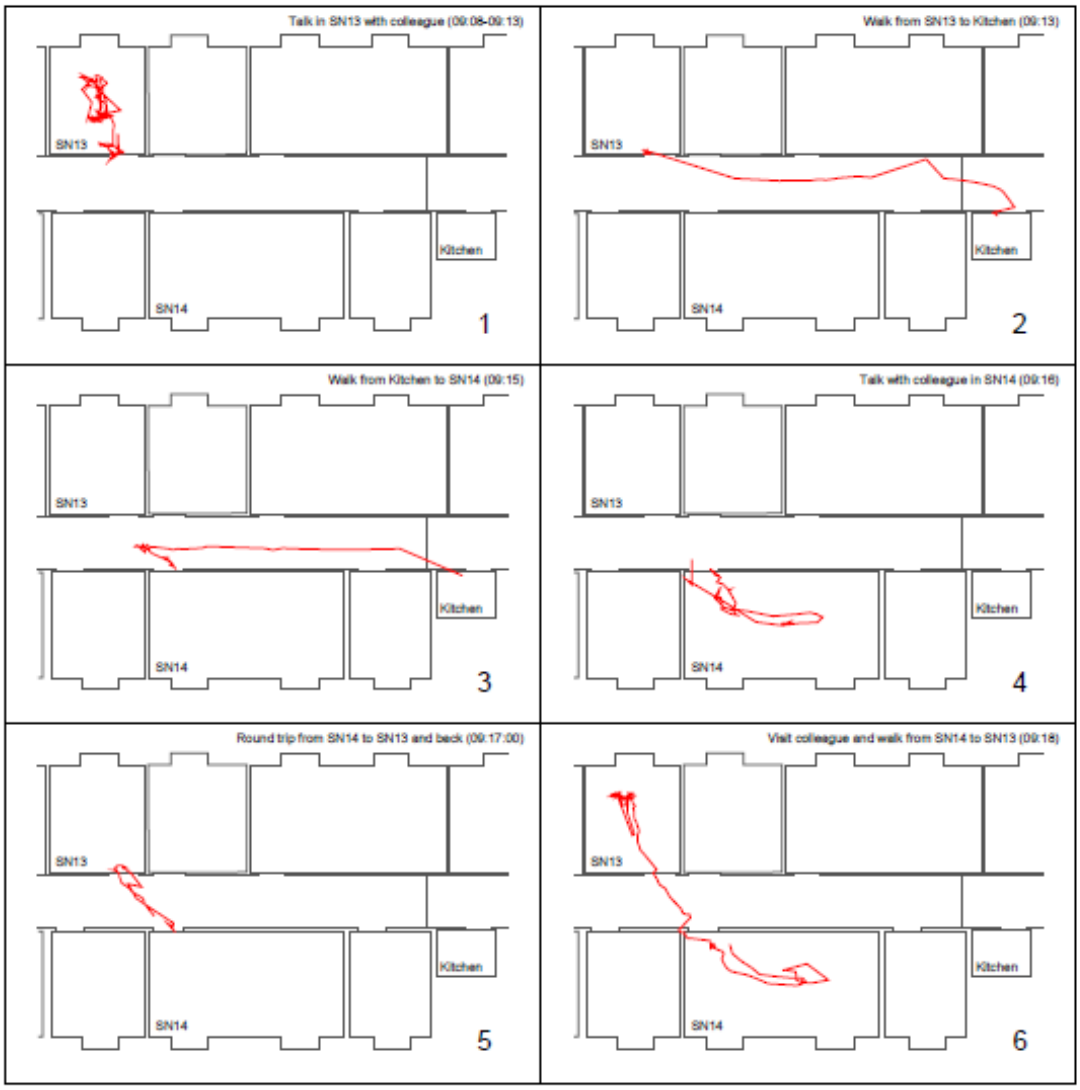
(Fig. 124) Home active design basic items.



(Fig. 125) Exercises that can be performed at home.



(Fig. 126) Example of energy expenditure of human movement in an interior environment, office.



(Fig. 127) Trips made by an example individual between 9:08 and 09:18.

7.4 Home Gym

Considering that the house became a space of entertainment, it also incorporates the function of the social space through the internet, or the social living room and the social kitchen, it also became the work space and main source of information, fulfilling the function of the library and workshop. Should the house incorporate spaces entirely directed to physical activity? If so how can these spaces be optimized for this function.

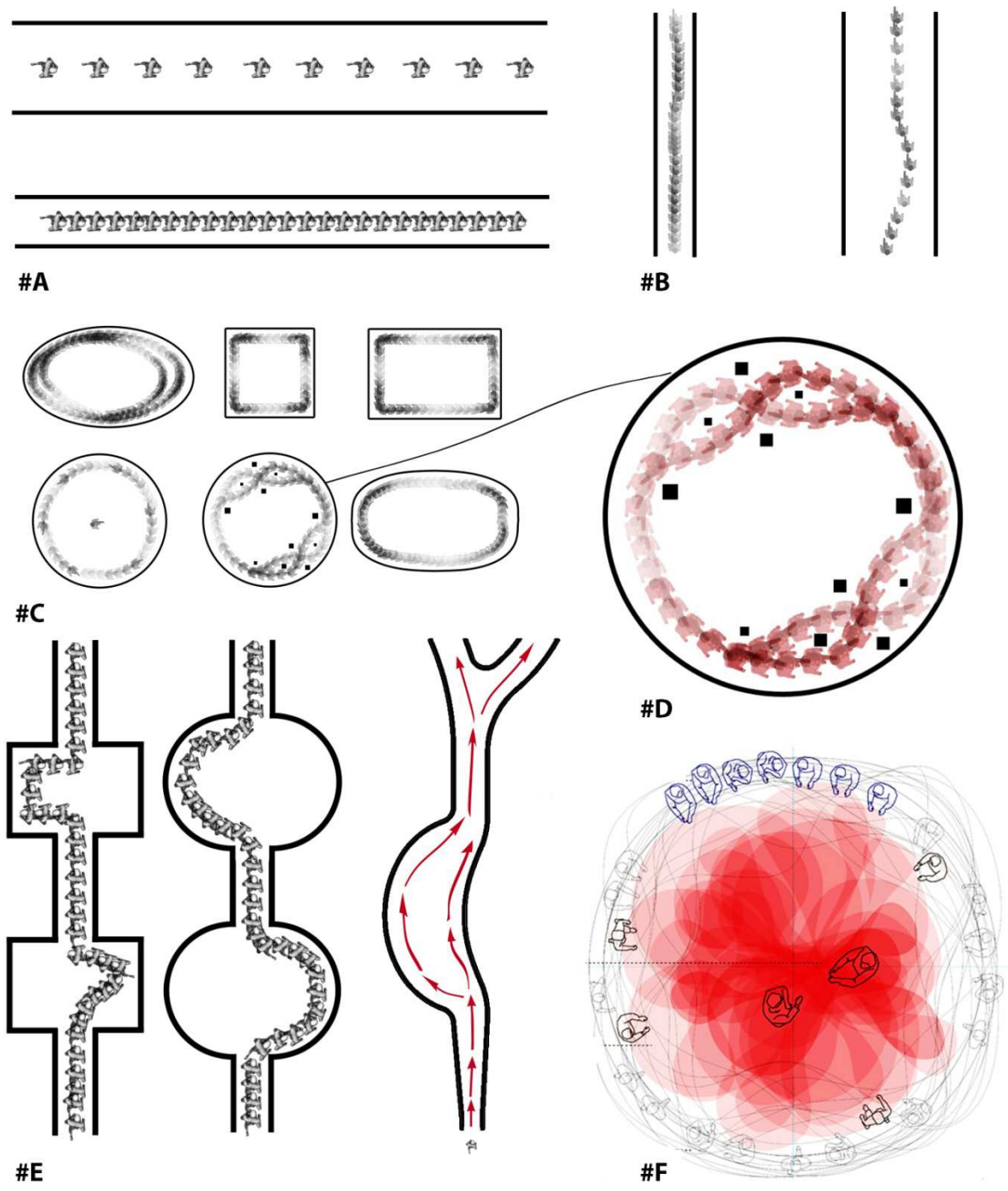
To further highlight what was previously mentioned, this function should primarily follow an hybrid or utilitarian active approach - which results when health or physical activity may not be the primary goal, although the individual may make a decision to be physically active while working toward that goal, such as choosing to use the stairs instead of the elevator (Zimring, et al., 2005 188). It should embed both the functions of work and activity, or both the functions of leisure and activity.

This gym space should focus on the capacity to move of the user. The key for any home gym is to make sure it's easy to adjust. Incorporating a set of free-weights is an affordable alternative, as it is resistance tubing. Equipment designed for home use can be a space obstruction, especially treadmills. Space limitations may mean opting for space-saving rack of dumbbells instead of a exercise machines (American Council on Exercise 1).

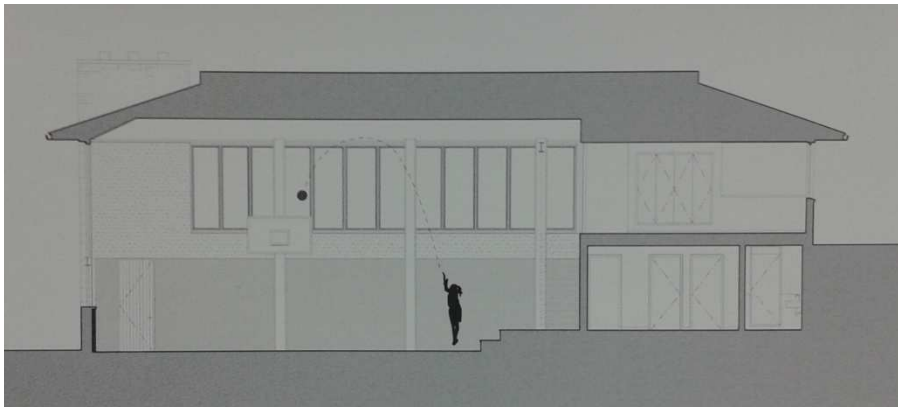
The equipment should be adjustable, the body should move in a correct and safe manner. Parts should be easily removed and replaced, and moving parts should lattice well. There should not be any design flaws or weaknesses that could increase the risk of injury (American Council on Exercise 1). Therefore, the space should have rounded edges for this question of avoiding accidents and also for easy cleaning.

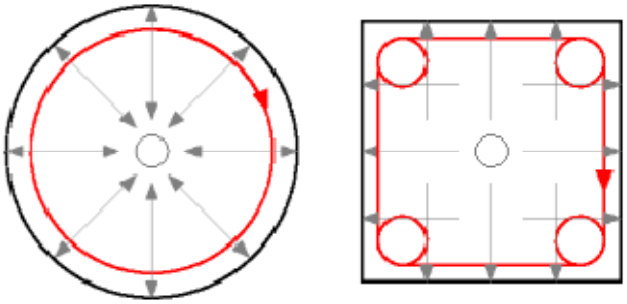
The home active space should have the dimensions of aproximately 300 cms radius to 600 cms radius as it was already discussed. The space should allow for the free movement of more than one body. This space needs to allow the individual to perform basic exercise, push-ups, handstands, aerobics, stretching, yoga or other. The basic elected shapes are the circular form, as it is the most intuitive form for a space of movement, but also the elipse and the oblong rectangles, see (fig.128) - (fig.133).

The home active space should be free of obstacles and barriers, or if it should have any, they should have a purpose. The active space must have a specific type of floor that prevents injuries in falls, polished wood floors are normally effective for this purpose. Color is a very relative element of the space and should be taken in account as a specific feature of the active space, however this space should have moderately bright colors and equipped with enough light for the purpose. Privacy and isolation of the space is also important to allow for a sense of concentration and meditation, appropriated for activities such as yoga and martial arts. The space can be centered in the building also functioning as a square or deambulatory inside the house.



(Fig. 128)(Fig. 129) A and B - Widening of the space allows for faster movement. (Fig. 130) C - Analysis of different spatial configurations. The most adecuate to movement is the circle. (Fig. 131) D - Movement in the circular space with obstacles. (Fig. 132) E - Comparison between different event spaces and synthesis: The active path composed of the widening of the space, a circular event space, and the multiple choice path. (Fig. 133) Analysis of the movement in a circular space, *"roda de capoeira".*





(Fig. 134) House Gym section.

(Fig. 135) Comparison of movement between a circular space and a quadrangular space. The circular space uses all the space uniformily. The quadrangular space leaves has the tendency to waste space in the corners which are left without possible movement.

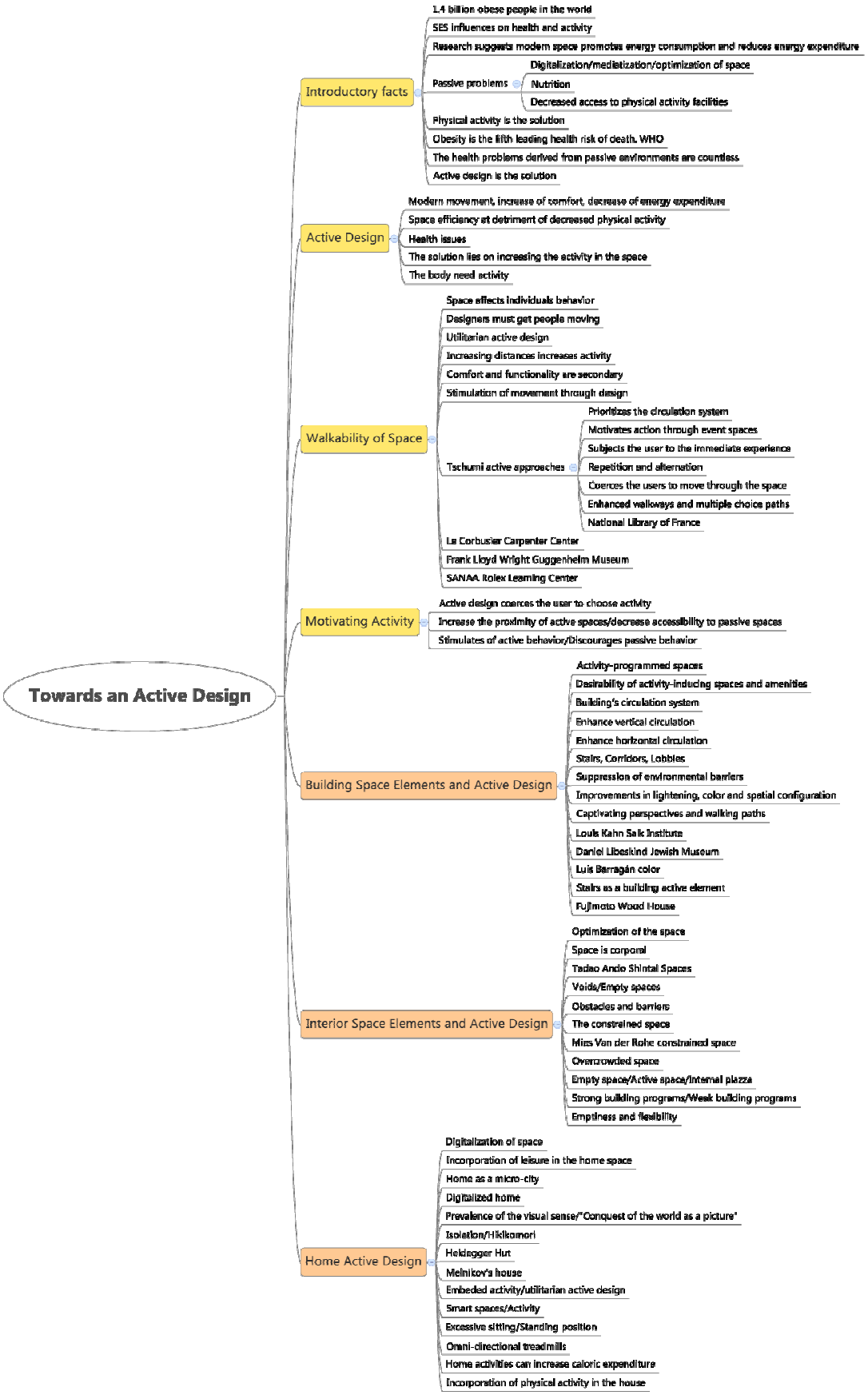
(Fig. 136) (Fig. 137)Examples of house gym spaces.

(Fig. 138) Climbing wall and ceiling in the interior space.

(Fig. 139) Climbing wall in the interior space.

(Fig. 140) Technical University of Munich slides.

(Fig. 141) Kazuki Nakamura and Kenichi Izuhara house with slides.



(Fig. 142) Thesis synthesis.

8. Conclusions

Technologies and architecture have been influential in the development of passive environments. This study has successfully identified the link between the sedentarization of humans, the passive environment and technologies. The mechanization, optimization and digitalization of the space are the blueprint of the contemporary problem of sedentarization. Consequently, sedentarization and passive environments are detrimental to human health because they discourage physical activity. However, physical activity can be enhanced by building design and spatial configuration therefore creating active environments.

Anything that stimulates users movement and that encourages them to interact should be implemented in the space. Including the home environment, it must discourage passivity and encourage activity. Architectural design could focus on strategies to incorporate movement and activity on the building program. These strategies must value freedom of movement and flexibility, therefore, aligning with the described weak program spaces. The architectural design approach must prioritize the circulation and activity patterns of users with the aim of promoting user activity. By designing the active space with features that better enhance motion and stimulate the human body through the senses, these features can encourage activity. Also, these features must prioritize accessibility to active spaces above those that are passive, by imposing engaging circulation systems that compete and best the passivity of the space. The implementation of the concept of active voids in the built environment allow wider and free paths that enhance movement. By interrupting the monotony of the circulation systems with event spaces and intervals that generate activity, the space breaks the routine and rewards the user, therefore improving its active enhancing properties.

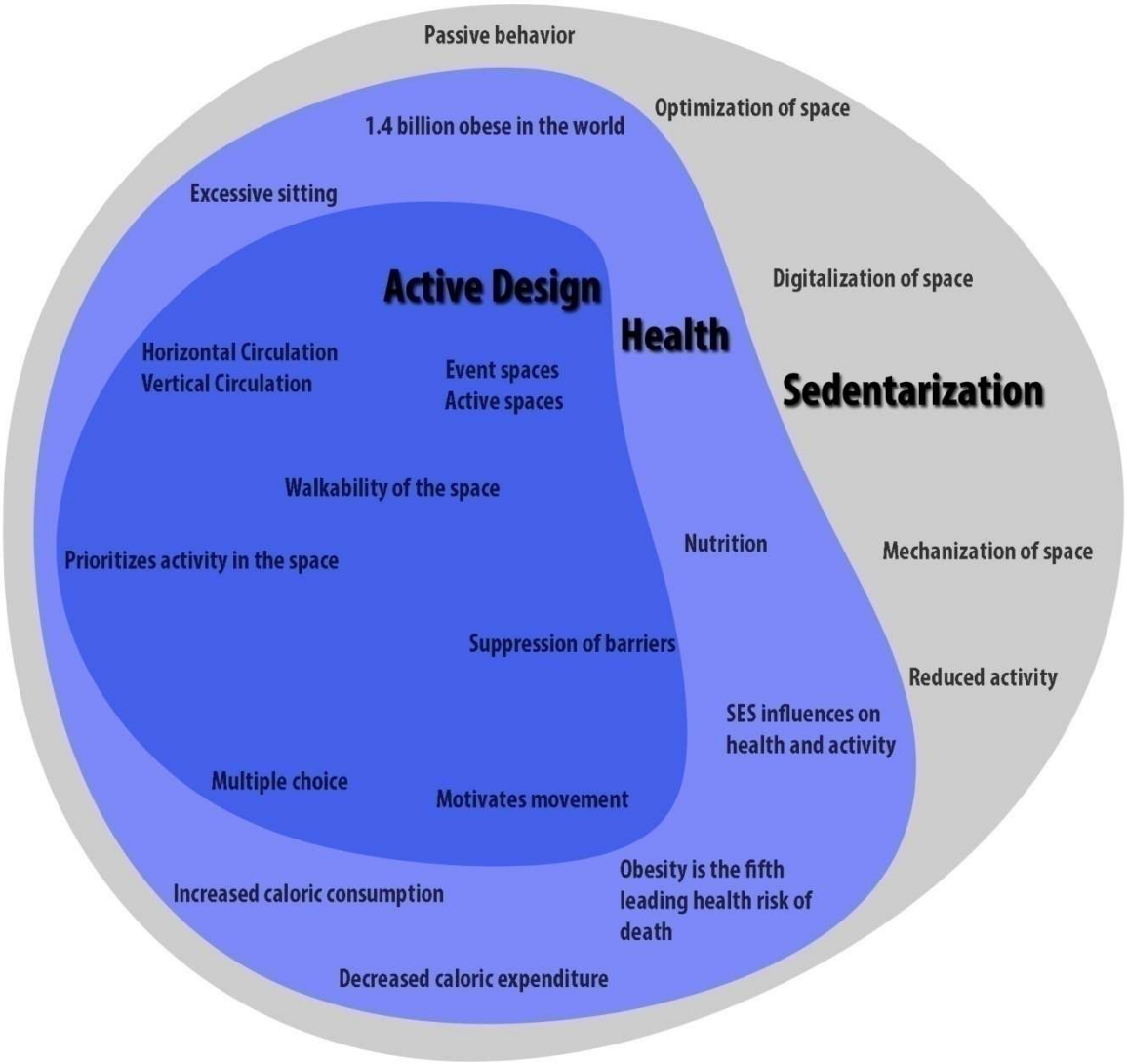
The active space should be clear and empty of obstacles. However, the space must break the monotony and should incorporate features that stimulate activity, therefore, active-friendly environments may collide with functionality for their spontaneity and complexity.

Technologies can be adapted in order to enhance activity through smart approaches.

The research also found that if users are motivated to be active by design, this can be used to reduce sedentary behavior. The architecture and design community should be more aware of the benefits of the active-friendly space.

In order to deal with the health related problems of the passive environment, further measures should be taken to improve the knowledge and interest of the public in this subject, and further research focusing on specific active elements such as the circulation systems, event spaces, stairs and the potentials of smart technologies, so that soon architectural design will acquire a new branch that prioritizes the health and wellbeing of users willing to be active.

(Fig. 143) Active design synthesis.



(Fig. 144) Thesis cartography.

Figures

Fig. 29 La surconsumation. http://vimeo.com/57126054

Fig. 30 La surconsumation. http://vimeo.com/57126054

Fig. 31 La surconsumation. http://vimeo.com/57126054

Fig. 32 La surconsumation. http://vimeo.com/57126054

Fig. 33 La surconsumation. http://vimeo.com/57126054

Fig. 34 La surconsumation. http://vimeo.com/57126054

Fig. 35 La surconsumation. http://vimeo.com/57126054

Fig. 36 La surconsumation. http://vimeo.com/57126054

Fig. 37 Frank and Engelke 2009.

Fig. 38 Manville and Bell 17.

Fig. 39 Fergus Bisset http://www.fergusbisset.com/projects/motivational-design-framework/

Fig. 40 Image by Tschumi http://www.tschumi.com/projects/3/

Fig. 41 http://cdn.architecturelab.net/

Fig. 42 Image by Tschumi http://www.tschumi.com/projects/14

Fig. 43 Image by Tschumi http://www.tschumi.com/projects/14

Fig. 44 Image by Tschumi http://www.tschumi.com/projects/14

Fig. 45 Image by Tschumi http://www.tschumi.com/projects/14

Fig. 46 Image by Tschumi http://www.tschumi.com/projects/14

Fig. 47 Image by Tschumi http://www.tschumi.com/projects/14

Fig. 48 Image by Tschumi http://www.tschumi.com/projects/14

Fig. 49 Image by Tschumi http://www.tschumi.com/projects/14

Fig. 50 Image by Tschumi http://www.tschumi.com/projects/14

Fig. 51 Image by Tschumi http://www.tschumi.com/projects/14

Fig. 52 Image by Tschumi http://www.tschumi.com/projects/14

Fig. 53 Image by Tschumi http://www.tschumi.com/projects/

Fig. 54 Image by Tschumi http://www.tschumi.com/projects/

Fig. 55 Image by Tschumi http://www.tschumi.com/projects/35/

Fig. 56 Image by Tschumi http://www.tschumi.com/projects/

Fig. 57 Image by Tschumi http://www.tschumi.com/projects/

Fig. 58 Image by Tschumi http://www.tschumi.com/projects/

Fig. 59 http://brianpodleski.wordpress.com/architectural-studio-work/le-corbusiers-carpenter-center-studies/

Fig. 60 http://brianpodleski.wordpress.com/architectural-studio-work/le-corbusiers-carpenter-center-studies/

Fig. 61 http://theeyethatwrites.blogspot.com.es/2012/03/normal_26.html

Fig. 62 http://arthistorygalore.files.wordpress.com/2011/03/simon-r-guggenheim-museum.jpg

Fig. 63 Image by SANAA http://www.archdaily.com/50235/rolex-learning-center-sanaa/

Fig. 64 Image by SANAA http://www.archdaily.com/50235/rolex-learning-center-sanaa/

Fig. 65 http://www.thefoxisblack.com/2011/08/23/rolex-learning-center-ski-club/

Fig. 66 http://www.thefoxisblack.com/2011/08/23/rolex-learning-center-ski-club/

Fig. 67 www.archdaily.com

Fig. 68 www.nationalgalleries.org

Fig. 69 http://sketch42blog.com/2013/07/luis-barragan-and-the-good-wall/

Fig. 70 http://wikimedia.org/

Fig. 71 http://thisisrealarchitecture.blogspot.com.es/2012/08/primitive-future-improvised-spaces-of.html

Fig. 72 http://thisisrealarchitecture.blogspot.com.es/2012/08/primitive-future-improvised-spaces-of.html

Fig. 73 http://thisisrealarchitecture.blogspot.com.es/2012/08/primitive-future-improvised-spaces-of.html

Fig. 74 http://www.housingprototypes.org/

Fig. 75 http://www.housingprototypes.org/

Fig. 76 Image by JDSA http://jdsa.eu/mar/

Fig. 77 Image by JDSA http://jdsa.eu/mar/

Fig. 78 Image by JDSA http://jdsa.eu/mar/

Fig. 79 Image by JDSA http://jdsa.eu/mar/

Fig. 80 Image by JDSA http://jdsa.eu/mar/

Fig. 81 Image by JDSA http://jdsa.eu/mar/

Fig. 82 http://www.archdaily.com/161522/ad-classics-koshino-house-tadao-ando/

Fig. 83 http://en.wikipedia.org/wiki/Tatami

Fig. 84 Yoshida 1935.

Fig. 85 Yoshida 1935.

Fig. 86 Yoshida 1935.

Fig. 87 www.archigraphie.eu/

Fig. 88 Hall 1966 16.

Fig. 89 Hall 1966 16.

Fig. 90 http://morrisblack.blogspot.com.es/

Fig. 91 http://www.haaretz.com/news/world/neil-armstrong-the-first-man-on-the-moon-dies-at-82-1.460684

Fig. 92 Rosenthal http://en.wikipedia.org/wiki/Raising_the_Flag_on_Iwo_Jima

Fig. 93 Jeff Widener http://en.wikipedia.org/wiki/Tank_Man

Fig. 94 http://postbubbleculture.blogs.wm.edu/2011/03/27/a-lonely-lockdown-the-hikikomori-phenomenon/

Fig. 95 http://do-while.com/rooms-of-japanese-teens/

Fig. 96 From the author.

Fig. 97 http://en.wikipedia.org/wiki/Ford_Model_T

Fig. 98 http://clockingdeadtime.blogspot.com.es/

Fig. 99 http://www.cardiff.ac.uk/archi/ahtg_heidegger.php

Fig. 100 http://www.chicagomag.com/Chicago-Magazine/C-Notes/October-2012/Richard-Pares-Soviet-Modernist-Architecture-Photography/

Fig. 101 www.enriquedelaosa.com/

Fig. 102 http://www.proludus.net/piano-stairs-thefuntheory/

Fig. 103 http://photos1.blogger.com/blogger/7039/3867/400/68470323.ibYR6Tbz._AntalLakner1.jpg

Fig. 104 http://www.acax.hu/content/.pictures/21/0001/view_000197.jpg

Fig. 105 Google. http://googleglasses.nu/

Fig. 106 http://www.brookstone.com/fitball-balance-ball-chair

Fig. 107 http://en.wikipedia.org/wiki/Architect

Fig. 108 http://www.bobvila.com/articles/diy-standing-desks/

Fig. 109 From the author.

Fig. 110 From the author.

Fig. 111 Images extracted from http://www.youtube.com/watch?v=nQR49JGySTM

Fig. 112 http://www.mseab.com/The-Virtual-Theatre.htm

Fig. 113 Virtusphere http://www.virtusphere.com/Product.html

Fig. 114 Virtusphere http://www.virtusphere.com/Product.html

Fig. 115 Virtusphere http://www.virtusphere.com/Product.html

Fig. 116 http://en.wikipedia.org/wiki/Omnidirectional_treadmill

Fig. 117 http://en.wikipedia.org/wiki/Omnidirectional_treadmill

Fig. 118 http://en.wikipedia.org/wiki/File:Virtuix_Omni_Skyrim_(cropped).jpg

Fig. 119 http://www.google.es/patents/US7780573

Fig. 120 http://www.google.ca/patents/US20120302408

Fig. 121 http://www.google.es/patents/US7780573

Fig. 122 http://calorielab.com/burned/

Fig. 123 http://www.workwhilewalking.com/

Fig. 124 http://www.ttnet.net/ttnet/gotoprd/SP300/190/0/15551303031353630303.htm

Fig. 125 http://www.revistacapoeira.com.br/en/saude/alongamento/

Fig. 126 Rassia et al., figure 3.

Fig. 127 Rassia et al.

Fig. 128 From the author.

Fig. 129 From the author.

Fig. 130 From the author.

Fig. 131 From the author.

Fig. 132 From the author.

Fig. 133 http://projectsreview2010.aaschool.ac.uk/

Fig. 134 Quartino 2009.

Fig. 135 http://simplydifferently.org/about

Fig. 136 Quartino 2009.

Fig. 137 Quartino 2009.

Fig. 138 http://www.tumblr.com/tagged/white-box

Fig. 139 http://gailcarriger.blogspot.com.es/2012/08/dear-lord-akeldama-2012-edition-part.html

Fig. 140 http://anotherhouseblog.com/2012/03/01/i-still-want-an-indoor-slide-in-my-house/

Fig. 141 dornob.com/321-go-slide-3-stories-down-2-sides-of-a-1-family-home/

Fig. 142 From the author.

Fig. 143 From the author.

Fig. 144 From the author.

Bibliography

Addy, C.L. et al. Associations of Perceived Social and Physical Environmental Supports With Physical Activity and Walking Behavior. *American Journal of Public Health.* 94(3). 2004. 440-443.

American Council on Exercise. Fit facts. "How to design your own gym." American Council on Exercise. 2009. Web. 23 August 2013. <http://www.acefitness.org/fitfacts/pdfs/fitfacts/itemid_2588.pdf>

Ando, T. *Shintai and Space*. In S. Marble et al., (Eds.) Architecture and Body. New York: Rizzoli, 1988.

Ando, T. *The Emotionally Made Architectural Spaces of Tadao Ando*. *Japan Architect* 276. 1980.

Arnau, J. *Espacios para la música.* Murcia : Nausíca Ä, 2005

Bachelard, Gaston. *The Poetics of Space*. Boston: Beacon, 1969.

Berman, Marshall. *All That is Solid Melts into Air.* The Experience of Modernity. New York: Penguin, 1982.

Bloomer, K.C., and Moore, C.W. *Cuerpo, memoria y arquitectura.* Madrid: Hermann Blume, 1982.

BMI Calculator "BMI Calculator" 2013. Web 16 of August 2013. <http://www.bmi-calculator.net/bmr-calculator/>

Booth, K. M., Pinkston, M.M., and Poston, W.S.C. Obesity and the Built Environment. *Journal of the American Dietetic Association.* 2 (45). 2005. S110-S117.

Boreham C, Wallace W, and Nevill A. Training effects of accumulated daily stair-climbing exercise in previously sedentary young women. *Prev Med*. 30. 2000. 277– 81.

Boutelle, K., et al. Using signs, artwork and music to promote stair use in a public building. *American Journal of Public Health*, 91, 2001.

Bray, G., and Bouchard C. *Handbook of Obesity: Clinical Applications,* Second Edition. New York: CRC. 2004.

Bruce, Peter. *Form follows fun: modernism and modernity in British pleasure, Architecture 1925-1940*. London and New York : Routledge, 2007.

Burney D, et al. *Active design guidelines: promoting physical activity and health in design.* New York City: City of New York, 2010.

Carnethon, M., et al. Worksite Wellness Programs for Cardiovascular Disease Prevention. *American Heart Association*. Circulation, 2009. 1725-1741.

Casa, Francesco. *Rolex Learning Center*; Lausanne: EPFL, 2010.

Cave B., and Molyneux P. Healthy Sustainable Communities: A Spatial Planning Checklist. Milton Keynes: *Milton Keynes South Midlands Health and Social Care Group*, 2004.

Certeau, Michel. *Walking in the City In The Practice of Everyday Life*. Berkeley: University of California, 1984.

Chaslin F., and Höfer C., *The Dutch Embassy in Berlin by Rem Koolhaas.* Rotterdam: Uitgeverij Nai, 2004.

Chilton, J.J., and Baldry, D. *The Effects of Integrated Workplace Strategies on Commercial Office Space Facilities*, Vol 15 (7/8) 1997. pp. 187-194

Committee on Physical Activity, Health, Transportation, and Land Use. *Does the Built Environment Influence Physical Activity?* Examining the Evidence. TRB Special Report 282. Washington DC: Transportation Research Board Institute of Medicine of the National Academies, 2005.

Corbusier, Le. *Towards an Architecture*. Los Angeles: Getty Research Institute, 2007.

Creek, Stevens. "Calorie Calculator" 1995-2001. Web. 16 of August 2013. <www.stevenscreek.com/goodies/calories.shtml>

Debord, Guy. *Commentaires sur la Société du Spectacle*, Paris: Editions Gerard Lebovici, 1988, translated by Malcolm Imrie as Comments on the Society of the Spectacle, London: Verso, 1991.

Debord, Guy. The Situationist International. Tom McDonough (Ed). Cambridge: MIT. 2002.

Debord, Guy. *The Society of the Spectacle*. New York: Zone Books, 1994.

Debord, Guy. "Introduction to a Critique of Urban Geography" 1955. Web. 26 of August 2013. <http://library.nothingness.org/articles/SI/en/display/2>

Dehghan, M., Akhtar-Danesh, N., and Merchant, A.T. Childhood obesity, prevalence and prevention. *Nutrition Journal*, 4, 2005: 4-24. doi:10.1186/1475-2891.1.4

Delva J., O'Malley P.M., and Johnston L.D. Racial/Ethnic and Socioeconomic Status Differences in Overweight and Health-Related Behaviors among American Students: National Trends 1986–2003. *J Adolesc Heal* 39(4). 2006. 536–545.

Derrida, Jacques. *Limited Inc.* Evanston: Northwestern University Press, 2000.

Dijkstra, K., Pieterse, M., and Pruyn, A. Physical environmental stimuli that turn healthcare facilities into healing environments through psychologically mediated effects: systematic review. *Integrative Literature Reviews and Meta-Analyses,* 2006.

Dodds, G. and Tavernor, R. *Body and Building. Essays on the Changing Relation of Body and Architecture*. London: The MIT, 2002.

Domenico, Giovanni di. *L'Idea di recinto. Il recinto como essenza e forma primaria dell'architettura.* Roma: oficina, 1998.

Eaton S.B., Konner M.J. Paleolithic Nutrition Revisited: A Twelve-Year Retrospective on its Nature and Implications. *European Journal of Clinical Nutrition*. 51. 1997. 207-216.

Eaton, B. An Evolutionary Perspective on Human Physical Activity: Implications for Health. *Comparative Biochemistry and Physiology.* 136. 2003. 153-159.

Ebert, Carola. *The Dilemma with Disjunction: Architecture and Discourse in Bernard Tschumi's Early Work. n.d.* Web. 10 August 2013. <e-pub.uni-weimar.de/opus4/files/1281/ebert.pdf>

Eisenman, Peter and Allen, Stan*. Strategies of the Void. Ten Canonical Buildings: 1950-2000*. New York: Rizzoli, 2008.

Epstein, L. H., and Roemmich, J.N. Reducing Sedentary Behavior: Role in Modifying Physical Activity. *Exercise and Sport Science Reviews*, 29(3), 2001. 103-108.

Epstein, Leonard. Integrating Theoretical Approaches to Promote Physical Activity. *American Jornal of Preventive Medicine.* 15(4). 1998. 257-265.

Ewing, R. et al. Relationship Between Urban Sprawl and Physical Activity, Obesity, and Morbidity. *American Journal of Health Promotion,* 18 (1), 2003. 47-57.

Fallon, Sally, and Enig, Mary G. Caveman Cuisine. *Price-Pottenger Nutrition Foundation Health Journal*, Weston A. Price Foundation. Vol 21, No 2. 1999. (619) 574-7763.

Ferrara, C. and Murphy, D. Motivational Signs, Artwork, and Stair Use in a University Building. University of Massachusetts Lowell. *Californian Journal of Health Promotion*. Volume 11, Issue1. 2013. 76-83

Finch, E. The Health Impact of Space Planning Policies in Relation to Walking and Exercise in the Workplace. Helsinki: Clima. 2007. 1725-1732.

Fitness Blender "How Many Calories does the Wii Just Dance Game Burn" 2013. Web. 16 of August 2013. <http://www.fitnessblender.com/v/article-detail/How-Many-Calories-does-the-Wii-Just-Dance-Game-Burn-/4h/>

Ford, Simon. *The Situationist International: A User's Guide*. London: Black Dog, 2005.

Forward, S. *Modes of transport on short journeys: attitudes and behaviour of the inhabitants of Gothenburg.* Linköping: Swedish Road and Transport Research institute. 1998.

Frampton, Kenneth. *Studies in Tectonic Culture: The Poetics of Construction in Nineteenth and Twentieth Century Architecture*. Cambridge: The MIT, 1995.

Frampton, Kenneth. *Le Corbusier.* London: Thames & Hudson, 2001.

Frank, L. D., Anderson, M.A., and Schmid, T.L. Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars. *American Journal of Preventive Medicine*, 27 (2), 2004. 1-13.

Frank, L.D., and Engelke, P.O. *Health and Community Design: The impact of the built environment on physical activity.* Washington, DC: Island Press. 2003.

Frank, L.D. and Engelke, P.O. The built environment and human activity patterns: exploring the impacts of urban form on public health. *Journal of Planning Literature.* 2001.

García-Goñi, Manuel and Hernández - Quevedo, Cristina. The evolution of obesity in Spain. Eurohealth, 18(1). 2012.

Gebel, K., et al. *Creating healthy environments: A review of links between the physical environment, physical activity and obesity*. Sydney: University of Sydney, NSW Health Department and NSW Centre for Overweight and Obesity. 2005. website: <http://sydney.edu.au/medicine/public-health/coo/publications/creatin.php>

Girard, Christian. *Back from Fast Forward: Architecture, Bodies and Icarian Technologies. The State of Architecture at the Beginning of the 21st Century.* New York: Monacelli Press, 2003.

Gray, Christopher. *Leaving the 20th Century: The Incomplete Work of the Situationist International.* London: Rebel, 1998.

Grobman, Y., and Amster, E., *Implications of Green Buildings and Climate Change on Human Health in Israel*. Harvard University and Haifa University: 2013. <http://grobman.net.technion.ac.il/files/2013/01/Implications-of-Green-Buildings-and-Climate.pdf>

Guallart, Vincente and Cantarella, Laura. *Media House project : the house is the computer, the structure is the network*. Barcelona : Institut d'Arquitectura Avançada de Catalunya, 2004.

Hall, Edward T. *The Hidden Dimension.* New York: Anchor Books, 1966.

Handy, S.L., et al. How the Built Environment Affects Physical Activity Views from Urban Planning. *American Journal of Preventive Medicine*, 23(2S), 2002. 64-73.

Hart, Joseph. "A New Way of Walking" 2004. Web. 26 of August 2013. <http://www.utne.com/2004-07-01/a-new-way-of-walking.aspx

Hebestreit, Helge and Oded, Bar-O. *The Young Athlete. Encyclopaedia of Sports Medicine.* IOC Medical Commission Publication, International Federation of Sports and Medicine. International Olympic Committee. Malden: Blackwell, 2008.

Heinen, L., and Darling, H. Addressing Obesity in the Workplace: The Role of Employers. The Millbank Quarterly, Vol. 87 (1). 2009. 101-122. Engineering. *American Journal of Preventive Medicine,* Elsevier. 1998. 124:264–70

Hensel, Michael. *Space reader, heterogenous space in architecture.* Padstow: Wiley, 2009.

Hertz, R.P. and McDonald, M. Obesity in the United States Workforce. *National Health and Nutrition Examination Surveys* III 1999-2000. 2004.

Howell, S. *Designing for aging: patterns of use*. Cambridge MA: MIT Press, 1980.

Hill, Jonathan, et al. Obesity and the environment: where do we go from here? *Science*. 299:853-5. 2000.

Hill, Jonathan. *Actions of Architecture*. New York: Routledge, 2003.

Hillier, B. *Space is the machine*. Cambridge: Cambridge University Press, 1996.

Hollier, Denis. *Against Architecture: The Writings of Georges Bataille*. Cambridge: MIT, 1989.

Huizinga, John. *Homo Ludens: A Study of the Play-Element in Culture.* Boston: Beacon Press, 1960.

Jackson, L.E. The Relationship of urban design to human health and condition. *Landscape and Urban Planning.* Vol. 64. 2002. pp. 191-200.

Jackson, R. The Impact of the Built Environment on Health: An Emerging Field. *American Journal of Public Health*, 93(9), 2003. 1382-1384.

Jacobson, M. Silverstein, M. and Winslow, B. *Patterns of Home: The Ten Essentials of Enduring Design*. Newton CT: Taunton Press, 2002.

Jago R,et al. Parental Sedentary Restriction, Maternal Parenting Style, and Television Viewing Among 10- to 11-Year-Olds. *Pediatrics*. 128(3): 2011. e572–e578.

Jormakka, Kari. *Flying Dutchmen: Motion in Architecture.* Basel: Birkhäuser, 2002.

Kahn, E.B., et al. The effectiveness of interventions to increase physical activity: a systematic review. *American Journal of Preventive Medicine*. 22:73. 2002.

King, A.C., and Sallis, J.F. Why and how to improve physical activity promotion: Lessons from behavioral science and related fields. *American Journal of Preventive Medicine.* 49(4): 2009. 286–288.

King A.C. et al. Theoretical Approaches to the Promotion of Physical Activity. *American Journal of Preventive Medicine*, Elsevier Science. 2002.

Knabb, Ken. *Situationist International Anthology*. Berkley: Bureau of Public Secrets. 1995.

Kottke, T.E., and Pronk, N.P. Physical activity: optimizing practice through research. *American Journal of Preventive Medicine.* 31. 2006. S8–S10.

Krizcek, K.J., Birnbaum, A.S., and Levinson, D.M. A Schematic for Focusing on Youth in Investigations of Community Design and Physical Activity. *American Journal of Health Promotion.* 19(1). 2004. 33-38.

Kumanyika, Shiriki Kinika, and Ross C. Brownson. *Handbook of Obesity Prevention A Resource for Health Professionals.* New York: Springer, 2007.

Marche, J. *The Familiar and the Unfamiliar in Twentieth- Century Architecture*. Urbana: University of Illinois, 2003.

Lawrence, Frank. Andresen, Martin A. and Schmid, Thomas L. Obesity Relationships with Community Design, Physical Activity and Time Spent in Cars. *American Journal of Preventive Medicine*, 2004.

Leibrock, C. *Design details for health: making the most of interior design's healing potential.* New York: John Wiley and Sons, 2000.

Lerup, Lars. *After the City*. Cambridge, MIT. 2000.

Levi, Jeffrey. et al. *F as in Fat: How Obesity Threatens America's Future*. Washington DC: Robert Wood Johnson, 2010.

Lévy-Leboyer, Claude. *Vandalism , Behavior and Motivations.* New York: Elsevier Science, 1984.

Lynch, K. *The image of the city*. Cambridge MA: MIT Press, 1960.

Mann, Neil (September). Meat in the human diet: an anthropological perspective. Nutrition & Dietetics. *Dietitians Association of Australia,* School of Applied Sciences, 64 (4): 2007.

Mansi, I.A., et al. Stair Design in the United States and Obesity: The Need for a Change. *Southern Medical Association.* 102(6). 2009. 610-614.

Manville, L., and Bell, F. Fit-City 2: Promoting Physical Activity through Design. *American Institute of Architects*. n.d.

Marrero, J., Region 5 Air and Radiation - Indoor Air Quality. 2011. Web. <http://www.epa.gov>

Martincigh L. *Attractiveness for Pedestrians: A Most Fickle Aspect of Urban Quality.* Portland: Fourth International Conference on Walking in the 21st Century, 2003.

MCLUHAN, Marshall. *Understanding Media: The Extensions of Man.* McGraw-Hill. New York, 1964.

McNeil L.H., and Kreuter M.W., and Subramanian S.V., Social environment and physical activity: a review of concepts and evidence. *Soc Sci Med.* 63: 2006. 1011-22.

Moreno, Luís A., Iris Pigeot and Wolfgang Ahrens. *Epidemiology of Obesity in Children and Adolescents: Prevalence and Etiology*. New York: Springer Science+Business Media, 2011.

MSE Weibull. "The Virtual Theatre and the Omnidirectional treadmill" n.d. Web. 19 of July 2013. <http://www.mseab.com/The-Virtual-Theatre.htm>

Nair, G. and Ditton, J. In the dark, a taper is better than nothing. A one year follow-up of a successful street lighting and crime prevention experiment. *Lighting Journal.* 59: 1994. 25–7.

Nicoll, G., and Zimring, C. Effect of Innovative Building Design on Physical Activity. *Journal of Public Health Policy,* 30, 2009. S111–S123.

Owen, N., et al. Understanding Environmental Influences on Walking. *American Journal of Preventive Medicine*. 27(1). 2004. 67-76

O'Keefe, Karen. "Obesity - Enabled by the Suburbs at a Heavy Cost". The Town Paper, 6: 2, 2004. Web. 20 of August 2013. <http://www.tndtownpaper.com/Volume6/obesity_at_heavy_cost.htm>

Oxford Dictionaries. "Definition of body in English". 2013. Web. 1 of August 2013. <http://oxforddictionaries.com/definition/english/body>

Paffenbarger Jr, et al. Physical activity, all-cause mortality, and longevity of college alumni. *N Engl J Med.* 314.1997. 605–13.

The Paleolithic Diet Nutrition Page. What Our Hunter/Gatherer Ancestors Ate. "Functional and Structural Comparison of Man's Digestive Tract with that of a Dog and Sheep." 1998. Web. 23 August 2013 <http://www.paleodiet.com/comparison.html>

Pallasmaa, Juhani. *Questions of Perception. Phenomenology of Architecture.* San Francisco: William Stout Publishers, 2006.

Pallasmaa, Juhani. *The Eyes of the Skin, Architecture and the Senses.* London: Academy Group LTD, 1996.

Pallasmaa, Juhani. *The Melnikov House*. London: Academy Editions, 1996.

Papas, Mia A. et al. The Built Environment and Obesity. *Epidemiologic Reviews*. Johns Hopkins Bloomberg School of Public Health. Vol. 29: 2007. 129-143.

Papadakis, A. *Deconstruction in Architecture.* New York: St. Martin's, 1988.

Parker D., and Joseph A. Creating environments to promote physical activity among older adults*. Presentation at Environmental Design Research Association* 34. 2003, Minneapolis MN, 2003.

Peponis, J., and Wineman J. *The spatial structure of environment and behavior: space syntax. Handbook of environmental psychology*. New York: John Wiley, 2002.

Plant, Sadie*. The Most Radical Gesture. The Situationist International in the Post Modern Age*. London: Routledge, 1992.

Presses Polytechniques et Universitaires Romandes. "EPFL / Rolex Learning Center - Francesco della Casa" 2010. Web. 19 of July 2013. <http://www.youtube.com/watch?v=l9tFqltBOdY>

The Pritzker Prize. "Biography". n.d. Web. 17 of July 2013. <http://www.pritzkerprize.com/1992/bio>

Quartino, D. S*. Inside out! : espacios exteriores de interior . Outside in! : espacios interiores de exterior.* Barcelona : Reditar Libros, 2009

Rapoport, A. *Human aspects of urban form: towards a man–environment approach to urban form and design.* New York: Pergamon Press, 1977.

Rassia et al., Movement Dynamics in Office Environments. n.d.

Regnier, V. *Assisted living housing for the elderly: design innovations from the United States and Europe.* New York: Van Nostrand Reinhold, 1994.

Research Board, Institute of Medicine of the National Academies, Committee on Physical Activity, Health, Transportation, and Land Use, Transportation. (). *Does the built environment influence physical activity? Examining the Evidence* 282. 2005 <http://www.trb.org/Main/Blurbs/Does_the_Built_Environment_Influence_Physical_Acti_155343.aspx> <http://www.pfizer.com/files/.../Obesity_in_the_United_States_Workforce.pdf>

Robroek, S.J.W., et al. The role of obesity and lifestyle behaviours in a productive workforce. *Occupational Environmental Medicine,* 68, 2011. 134-139.

Sallis, J. F., and Glanz, K., Physical Activity in food environments: Solutions to the Obesity Epidemic. *The Milbank Quarterly*, 87(1), 2009. 123–154.

Sennett, Richard. *Flesh and Stone, The body and the City in Western Civilization*. New York: Norton, 1994.

Seneviratne, P.N. Acceptable walking distances in central areas. *J. Transportation Engineering.* 111. 1985. 365–76.

Sharr, Adam. *La Cabaña de Heidegger. Un espacio para pensar.* Barcelona: Gustavo Gili, 2008.

The Situationist City. 2006. Web. 26 of August 2013. <http://www.systemed.net/blog/legacy/entry060413015813.html>

Starfield B., Robertson J., and Riley AW. Social class gradients and health in childhood. *Ambulatory pediatrics. Ambulatory Pediatric Association,* 2(4): 2002. 238–246.

Stone, J. "Designers are Motivators Perspective" 2008. Web. 25 of August. <http://www.iida.org>; <http://www.iida.org/resources/category/2/7/8/documents/0608designers-are-motivators.pdf>

Swinburn, B., Egger, G., and Raza, F. Dissecting Obesogenic Environments: The Development and Application of a Framework for Identifying and Prioritizing Environmental Interventions for Obesity. *Preventive Medicine*, 29, 1999. 563-570.

Tabor, P. *Traffic in buildings 1: Pedestrian Circulation in Offices*. Cambridge: University of Cambridge School of Architecture. 1971.

Tafuri, Manfredo. *Architecture and Utopia: Design and Capitalist Development.* Cambridge: MIT Press, 1976.

TDM Encyclopedia. "Walkability Improvements" 28 of August 2013. Web. 31 of August 2013. <http://www.vtpi.org/tdm/tdm92.htm>

Technische Universität München "Cyberwalk - Ungehindertes Gehen in Virtullen Welten" 2013. Web. 20 of July 2013. <http://www.amm.mw.tum.de/en/research/completed-projects/cyberwalk/>

Transportation Research Board. *Does the built environment influence physical activity? Examining the Evidence.* Washington DC: Institute of Medicine of the National Academies, Committee on Physical Activity, Health, Transportation, and Land Use, Transportation. 2005.

Tschumi, Bernard. *Architecture and Disjunction*. London: The MIT, 1996.

Tschumi, Bernard. *Event-cities 2.* Cambridge, MIT. 2000.

Tschumi, Bernard. "Bernard Tschumi Architects" 2013. Web. 8 of August 2013. <http://www.tschumi.com/>

Tooby, J., and Cosimides, L., The Past Explains the Present. Emotional Adaptations and the Structure of Ancestral Environments. *Ethology and Sociobiology.* 11. 1990. 375-424.

Turner A, and Penn A. Encoding natural movement as an agent-based system: an investigation into human pedestrian behaviour in the built environment. *Environ Planning B: Planning and Design* 2002; 29(4): 473–90.

U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General*. Atlanta, GA: U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, 1996.

U.S. Department of Health & Human Services "FDA U.S. Food and Drug Administration" 2013. Web. 16 of August 2013. <http://www.fda.gov/>

Valera G., and Silvestre D*., Obesidad en el S.XXI: ¿qué se puede y se debe hacer?* Madrid: International Marketing and Communication, 2009.D

Vlahos, J. “Is Sitting a Lethal Activity?,” The New York Times, 14 April 2011. Web. 3 May 2011. <http://www.nytimes.com/2011/04/17/magazine/mag-17sitting-t.html>

Vaneigem, Raoul. *The Revolution of Everyday Life*. London: Left Bank Books and Rebel Press, 1983.

Vidler, Anthony. *The Architectural Uncanny, Essays in the Modern Unhomely.* Cambridge: MIT. 1992.

Virtuix Omni "Virtuix Omni" 2013. 20 of July 2013. <http://www.virtuix.com/about/>

Virtusphere "Virtusphere" 2013. Web. 2 of August 2013. <http://www.virtusphere.com/>

Voegtlin, Walter L. *The Stone Age Diet: Based on in-depth studies of human ecology and the diet of man*. New York: Vantage Press, 1975.

Vuori I.M., Oja P., and Paronen M. Physically active commuting to work-testing its potential for exercise promotion. *Med Sci Sports*. 26: 1994. 844 –50.

Ward, Peter. *History of Domestic Space: Privacy and the Canadian Home*. Van couver: UBC, 1999.

Wegmann F.J., and Jang T.Y. Trip linkage patterns for workers. *J Transportation Engineering* . 124: 1998. 264–270.

Weich S., et al. Measuring the built environment: validity of a site survey instrument for use in urban settings. *Health Place*. 7. 2001. 283-292.

Wells, N.M., et al. Environment, Design, and Obesity: Opportunties for Interdisciplinary Collaborative Research. *Environment and Behavior.* Vol, 39(6). 2007. pp. 6-33.

White House, "V. Physical Activity" 2010. Web. 26 of August 2013. <http://www.letsmove.gov/sites/letsmove.gov/files/TFCO_Increasing_Physical_Activity.pdf>

Wikipedia. "Psychogeography" 2013. Web. 26 of August 2013. <http://en.wikipedia.org/wiki/Psychogeography>

Wikipedia "Built Environment" 2013. Web 20 of August 2013. <http://en.wikipedia.org/wiki/Built_environment>

Willoughby, T. M. Building forms and circulation patterns. *Environment and Planning B: Planning and Design* 2(1) London: 1975. 59-87.

Winzen, M., and Fritz Nicole. *Bodycheck*. Köln: Snoeck, 2007.

Wolman, Gil. "Address by the Lettrist International Delegate to the Alba Conference of September" 1956. Web. 26 of August 2013. <http://www.cddc.vt.edu/sionline/presitu/wolman.html>

World Health Organization. "Controlling the global obesity epidemic" 2004. Web. 23 of August 2013. <http://www.who.int/nutrition/topics/obesity/en/>

World Health Organization. "Global strategy on diet, physical activity and health" 2004. Web. 23 of August 2013. <http://www.who.int/dietphysicalactivity/strategy/eb11344/strategy_english_web.pdf>; <http://www.who.int/dietphysicalactivity/childhood/en/>

World Health Organization. "Obesity and Overweight" 2013. Web. 23 of August 2013. <http://www.who.int/mediacentre/factsheets/fs311/en/>

World Health Organization. "Physical Activity" 2013. Web. 25 of August 2013. <http://www.who.int/dietphysicalactivity/pa/en/>

Wortmann, A. Melnikov: *The Muscles of Invention*. Rotterdam: Van Hezik-Fonds 90, 1990.

Yancey, A.K., Pronk, N.P., and Cole, B.L. Workplace Approaches to Obesity Prevention. In S. Kumanyika, R.C.Brownson (Eds.), Handbook of Obesity Prevention, *Resource for Health Professionals*. 2007. pp 317-347

Yoshida, Tetsuro. *Das japanische wohnhaus*. Berlin : Ernst Wasmuth, 1935.

Zacharias, J. The impact of layout and visual stimuli on the itineraries and perception of pedestrians in a public market. *Environ Planning B.* London: Pion, 1997.

Zimring, C., et al. Influences of Building Design and Site Design on Physical Activity Research and Intervention Opportunities. *American Journal of Preventive Medicine* 28, 2005. 183-196

Zimring, C. Walking on Campus: Correlates and Web Tools. National Institute of Environmental Health Sciences. Georgia Institute of Technology, College of Architecture. 2007. Retrieved from: <http://herg.gatech.edu/Files/walking_on_campus_2007_report.pdf>

Zumthor, Peter. *Thinking Architecture*, 2nd, expand ed. Basel: Birkhäuser, 2006.